V.32bis/32
14400/9600bps
MODEM
V.42bis

USER'S MANUAL

FCC Connection Information

FCC Part 68

This equipment complies with Part 68 of the FCC Rules. On the bottom of this equipment is a label that contains the FCC Registration Number and Ringer Equivalence Number (REN) for this equipment. You must provide this information to the telephone company upon request.

The REN is useful to determine the quantity of devices you may connect to the telephone line and still have all of those devices ring when your number is called. In most, but not all areas, the sum of the REN's of all devices connected to one line should not exceed five (5.0). To be certain of the number of devices you may connect to your line, as determined by the REN, you should contact your local telephone company to determine the maximum REN for your calling area.

If the modem causes harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance. But if advance notice isn't practical, you will be notified as soon as possible. You will be advised of your right to file a complaint with the FCC.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of your equipment. If they do, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

If you experience trouble with this modem, please contact your dealer for repair/warranty information. The telephone company may ask you to disconnect this equipment from the network until the problem has been corrected or you are sure that the equipment is not malfunctioning.

This equipment may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

Installation

This device is equipped with a USOC RJ11C connector.

FCC Part 15

The modem generates and uses radio frequency energy. If it is not installed and used properly in strict accordance with the user's manual, it may cause interference with radio and television reception. The modem has been tested and found to comply with the limits for Class B computing devices in accordance with the specifications in Subpart B, Part 15 of the FCC regulations. These specifications are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. FCC regulations require that shielded interface cables be used with your modem.

If interference does occur, we suggest the following measures be taken to rectify the problem:

1) Move the receiving antenna.
2) Move the modem away from the radio or TV.
3) Plug the modem into a different electrical outlet.
4) Discuss the problem with a qualified radio/TV technician.

CAUTION : Changes or modifications not expressly approved by the party responsible for compliance to the FCC Rules could void the user's authority to operate this equipment.

Cable connections :

All equipment connected to this modem must use shielded cable as the interconnection means.

Introduction

Congratulations! You have purchased the modem, the finest, smartest, 14400 bps fax modem series available.

These modem series are high performance full-duplex asynchronous and/or *synchronous modem. Using state-of-the-art VLSI and signal processing technology, it provides enhanced performance and reliability.

These modems satisfy telecommunications requirements specified in CCITT recommendations V.32 bis, V.32, V.22bis, V.23, V.22, V.21 and compatible with Bell 212A and Bell 103. It fits most applications of full-duplex 14400/9600/4800 bps, 2400 bps and 1200 bps fall-back (asynchronous and *synchronous) and 0-300 bps asynchronous data transmission over the public switched telephone network (PSTN), andover point-to-point two-wire leased lines. In asynchronous mode, it also provides CCITT V.23 1200/75 bps communication, MNP class 2-4 error correction & MNP class 5 data compression, and CCITT V.42 error correction & CCITT V.42 bis data compression (optional).

By using easy to use commands, this modem can dial calls automatically in either touch-tone or pulse telephone system. It can also answer incoming calls automatically, enabling the user to leave his or her computer unattended without the threat of missing important transmissions. This manual is as easy to use as your modem. It contains 10 chapters and appendices.

Chapter 1, Installation: Describes the unpacking and installation procedure of the modem.

Chapter 2, Operating the modem: Describes the modem's two operating modes and the way to switch between these modes.

Chapter 3, Command line syntax and response codes: Explains how to send commands to the modem. Also describes the response codes the modem sends to the terminal after its execution of the command.

Chapter 4, Commands : Lists alphabetically the modem's standard "AT" commands, MNP commands, and CCITT V.42 bis/

*** For the External Modem only**

V.42 commands.

Chapter 5, Modem's S-registers: Explains the purpose of modem register and the way to read and change register values.

Chapter 6, Dialing a call: Provides examples of various dialing procedures.

Chapter 7, Answering incoming calls: Provides examples of answering incoming calls manually and automatically.

Chapter 8, Non-volatile memory : Describes the modem's non-volatile memory and the way to store and recall it.

***Chapter 9,** Operating synchronously (for external modem only) : Describes how to operate the external modem synchronously.

Chapter 10, Diagnostics: Describes the tests for troubleshooting the modem, the communication link and the remote modem.

Appendix A, Specification: Lists the specifications of the modem.

Appendix B, Modular telephone diagrams: Lists the modular telephone diagrams, dial-pulse and touch-tone specifications.

Appendix C, ASCII character table: Lists all the ASCII characters and their decimal and hexadecimal equivalents.

***Appendix D,** RS-232C pin assignments (for external modem only) : Provides RS-232C connector pin assignments and circuit descriptions of each signal.

Appendix E, Application Notes : To help users set up the modem for leased-line, error correction & data compression mode operation, and configure for various communication softwares.

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*** For the External Modem only**

Chapter 1 Installation

This manual describes installation of the external and internal modem. Set up your modem according to hardware configuration you get.

Unpacking the Modem

The complete package includes:

1) The modem unit or modem card
2) The user's manual
3) An RJ-11 modular phone cable
4) Communications software (optional)
5) A power adaptor (for external modem only)

Carefully inspect for shipping damage. If any is found, immediately repack the modem into the original packing material and contact your dealer.

*Part I *Installing The External Modem*

Look at the Modem

There are eleven LED indicators on the front panel of your modem as shown. In the schematic below (Fig1-1, the front panel of the modem) each of which displays an operational status. They are:

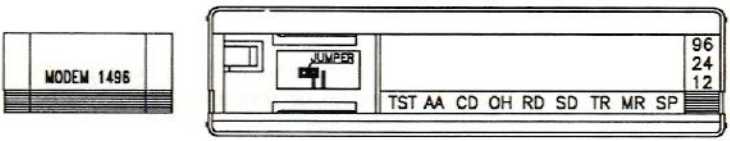


Fig 1-1 The front panel of the modem

* For the External Modem only

Light	Meaning		Function
TST	Error correcting	FLASH	The modem detects an error and is correcting it with error correction & data compression models.
		OFF	Normal or no error has been detected.
AA	Auto answer	ON	The modem is configured to automatically answer incoming calls.
		OFF	The modem is not configured for auto answer.
		FLASH	The modem receives incoming ring.
CD	Carrier detect	ON	The modem detects a remote modem's carrier signal.
		OFF	The modem does not detect a remote modem's carrier signal.
OH	Off-hook	ON	The modem is off-hook.
		OFF	The modem is on-hook.
RD	Receive data	ON	The modem is receiving data from a remote computer. The modem is configured for full-dulex, and its echo feature is turned on, when you send a command to your modem, it will return a response to you.
		OFF	The modem is neither receiving data from a remote computer nor receiving a command from you.
SD	Send data	ON	You are either entering a command to the modem or transmiting data to a remote computer.
		OFF	The modem is neither receiving a comm-

*** This page is for the External Modem only**

			and from you nor transmiting data to a remote computer.
TR	Terminal ready	ON	The modem is receiving a TR signal from DTE to denote that it is ready to transmit data.
		OFF	The modem is not receiving a TR signal from DTE.
MR	Modem ready	ON	The modem is turned on.
		OFF	The modem is turned off.
		FLASH	The modem is in self-test mode.

SP(spped)	96	24	12	
96/24/12	ON	ON	ON	This modem is operating at 14400 bps
	ON	OFF	OFF	This modem is operating at 9600 bps
	ON	ON	OFF	This modem is operating at 4800 bps
	OFF	ON	OFF	This modem is operating at 2400 bps
	OFF	OFF	ON	This modem is operating at 1200 bps
	OFF	OFF	OFF	This modem is operating at 300 bps

Configuring the modem for "dumb" mode

If you want your modem to ignore commands from the DTE and not send any responses to you, you can configure the modem for "dumb" mode using the "dumb" mode strap. This strap is located behind the front panel on the left side (the end cap).

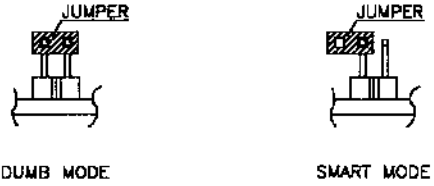


Fig 1-2 Dumb / smart mode selection

To configure the modem for "dumb" mode, use the following procedure:

1) Remove the end cap from the front panel .(Use your thumb, press and push the end cap to the left).

2) To configure the modem to "dumb" mode, insert the strap, then turn power off and on again.

At the factory, the jumper is installed in the "smart" position so that the modem recognizes commands and echoes response codes to the computer screen. This is for general use with dial-up modem operation.

If the jumper is set to the"dumb" position, the modem ignores commands and refrains from sending response codes so that it is configured as a dedicated auto-answer modem or for synchronous mode 2 (by & Q2 command) or mode 3 (by & Q3 command) operation.

The rear panel

On the rear panel of the modem are the power switch, the power jack, and RS-232C connector and two modular jacks, as shown in the schematic below.

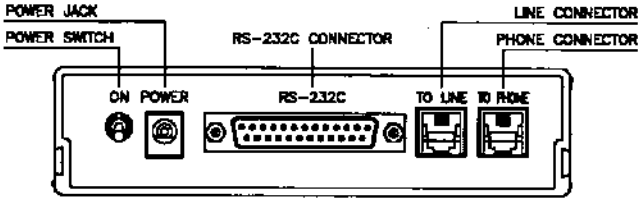


Fig 1-3 The rear panel of the modem

The power switch

Toggling the power switch to "ON" turns the modem on , while toggling the switch to "OFF " turns the modem off. It is recommended that you always turn on your computer prior to turning on the modem, and turn off your modem prior to turning off the computer.

*** This page is for the External Modem only**

The power jack & power adaptor

The power jack is for the power adaptor which is includes with your modem. This modem uses an AC 12V power adaptor. Always use one of the correct specification, such as the one supplied with your modem. An out of specification adaptor may damage the modem.

The RS-232C connector

The RS-232C connector can be connected to the serial port of the computer through an RS-232C cable. Your computer or terminal must have an industrial standard RS-232C serial port to use this modem. Please have an RS-232C port (available from your dealer) installed if your computer does not have one.

The modem can be connected to the serial port of the computer via a serial cable. Be sure to specify the appropriate type of connector (DB-25 or DB-9, male or female) for each end of the cable. Your modem follows industry standards in wiring the pins of the cable connectors, therefore, any cable that would connect a modem to your computer will work. Refer to Appendix D, or consult your dealer if you need the pin assignment of the connector.

The modular telephone jacks

The two modular jacks labelled "TO LINE" and "TO PHONE", located on the right side of the rear panel, are for the connecting cables from the wall outlet of the telephone line and the telephone set, respectively.

Be sure that the telephone system and line condition are in good order before connecting the modem. Test the line by lifting the telephone handset and listening for a clear dial tone. Next, try placing a couple of calls. If the calls do not go through well or are not loud and clear, you may have a poor quality telephone line, in which case you should find a better quality line.

NOTE : We strongly recommend that you connect the modem directly to an outside telephone line. Do not hook your modem to a business telephone system (PBX) unless the system is guaranteed to be good enough for data transmission.

Please bear in mind that a high quality telephone line contributes very much

to reliable data transmission.

Installing the Modem

Your modem fits neatly beneath a standard telephone set. The distance between the computer and the modem will be determined by the length of the RS-232C cable. A suitable location for your modem should be:

1) Near a reliable AC power source.
2) Close to a good quality telephone line wall outlet.
3) Where the LED indicators on the front panel are clearly visible.
4) Where the power switch is easily reached.
5) Where you are able to monitor the modem's carrier signal.

To connect the hardware, Please follow the procedures below:

1) Make sure both the modem and the computer are turned off.
2) Connect the modem to the Computer:
   Use a RS-232C cable between the modem and the computer. Plug the male DB-25 connector of the RS-232C cable to the modem.
   Then, plug the other end of the cable to your computer serial port. Secure all of the screw on the connectors.

> **NOTE:** Write down the computer serial port number (COM1,COM2, COM3, COM4,) to which you have connected the modem. This port number should be identical to the number listed in the commuication software configuration.

3) Connect the modem to a telephone line:
   Unplug the cable of your telephone set from the wall outlet.
   Plug one end of the supplied telephone cable to the outlet.
   Then, plug the other end to the jack marked "TO LINE" on the rear panel of the modem.
4) Connect a telephone set to the modem:
   Insert the plug you have just unconnected from the wall outlet to the jack marked "TO PHONE" on the rear panel of the modem. You may leave the "TO PHONE" jack unconnected if you don't need a telephone.
5) Connect the power supply to the modem:
   Insert the plug of the power adaptor into the jack marked "POWER" on the rear panel of the modem.

*** This page is for the External Modem only**

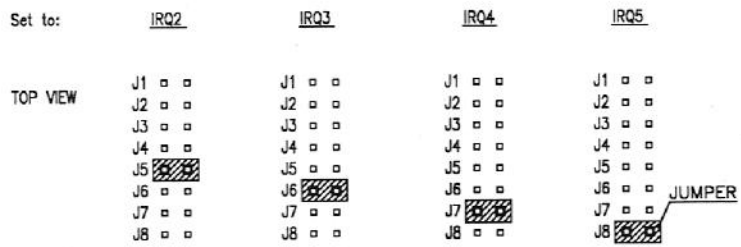
If you have connected a telephone set to the modem through "TO PHONE" jack, you can test the telephone line connection by lifting telephone handset and listening for a dial tone. Try to place some calls now. If the call can not go through well or is not loud and clear, you may have a poor or incorrect connection. Carefully repeat steps 3) and 4) again.

*Part II **Installing The Internal Modem Card*

Setting the modem card for the communication port

Before plugging the modem into slot in your computer, You should set the modem for the port chosen. To do this, simply change the configuration jumper located at the lower right corner of the modem card. The table on page 1-8 lists settings for each port.

An interrupt line should also be assigned to control the communication interface between your computer and the modem. If the modem is set for COM1 the default interrupt line setting is IRQ4 which is good for most situations. But, if the modem is set for COM3, you might have to choose between IRQ4 and IRQ5 for COM4; if the modem is set to for COM4, you might have to choose between IRQ3 and IRQ2 for IRQ4, The modem has four jumpers for setting the IRQ's, they are labeled J5/J6/J7/J8. The factory setting is IRQ4.



*** The 1st paragraph is for the External Modem only**
**** For the Internal Modem card only**

Configuration setting for port and interrupt

Port	J1	J2	J3	J4	Address	Interrupt	J5	J6	J7	J8
COM1:	#	#			3F8-3FF	IRQ4(default)			#	
COM2:	#			#	2F8-2FF	IRQ3		#		
COM3:		#	#		3E8-3EF 3E8-3EF	IRQ4 IRQ5			#	 #
COM4:			#	#	2E8-2EF 2E8-2EF	IRQ3 IRQ2	 #	#		

: mean short pin.

A "port" in a computer denotes a portion of computer address assigned to handle interface with a peripheral. Depending on how the computer is designed, port can be serial or parallel, and a computer can have several ports.

Each peripheral device, including your modem, must be assigned to a port so that the computer knows exactly where to find it. Two peripherials connot be assigned to one port, otherwise they will conflict with each other.

Your modem should be used with a serial interface port which could be either COM1, COM2, COM3, or COM4. Howerver, some computer, such as the IBM PC, support only two serial ports. Refer to the computer operations manual to determine how many ports your computer supports.

Choose one of the serial ports COM1, COM2, COM3, COM4, for your modem. Before delivery, your modem is set for use port COM1. If there is already a peripheral on COM1 such as a multifunction card or a mouse, you may choose to set use the modem on another port (such as COM2); or modem on COM1, No matter which port you choose for the modem, make such there is no other peripherals using that port.

In some system, some add-on card such as multifunction card is fixed at COM1 ans IRQ4, and there's also a mouse card use COM2 and IRQ3. In this case, your can configure the modem for COM3 and IRQ5 (or COM4 and IRQ2).

*** This page is for the Internal Modem only**

Write down the port number on a piece of paper of as you will need it later. If you have problems in choosing a port, consult an experienced computer technician.

Plugging the modem card into the computer

After setting the configuration switch, use the following procedures to install the modem into the computer :

1) Make sure that the computer is turned off and unplugged from the power source.

2) Remove the cover of your computer to explore the expansion slots. (See the computer's installation guide for instructions.)

3) Choose an expansion slot which is not being used. Use an appropriate screwdriver to unscrew the screw which holds the metal bracket of the slot. Save the screw as you will need it later.

4) Remove the metal bracket and set it aside.

5) Hold the modem card by its top edges and align it with the expansion slot. Make sure that the gold edge connectors (golden fingers) are exatlly aligned with the expansion slot.

CATION : Be careful to handle the modem card by its edges only. The precision components on the card can be easily damaged by static electricity or physical abuse.

6) Carefully and gently press the card down into the slot. The top of the metal bracket on the modem card should rest exactly on the rear panel bracket of the computer. If this is not the case, remove the modem card and try again.

7) Secure the modem card with the screw you have previously removed.

Connecting the modem card to a reliable telephone line

Be sure that the telephone system and line condition are in good working order before connecting the modem. Test it by lifting the telephone handset and listening for a clear dial tone.

Next, try placing a couple of calls. If the calls cannot go throught well or are not loud and clear, you may have a poor quality telephone line, in which case you had better find a good telephone line for your modem. Always remember that a high-quality telephone contributes heavily to reliable data transmission.

Also, you will need to know whether the telephone line uses a tone or pulse dialing system. Check with the local telephone company for this information.

There are two phone jacks on the side of your modem with the metal bracket. The lower jack, which is marked "TO LINE", should be connected to the wall outlet of a telephone line. Use the modular telephone cable included with your modem for this. If modular cable does not fit, consult your dealer to obtain a correct one.

You may wish to connect a telephone set to the upper jack marked "TO PHONE" so that you can use the phone on the same line. or if you prefer, you may leave the jack unconnected. It is recommended that you connect the modem to a direct outside telephone line. If the modem has to be connected through a PBX sustem, mark sure that the PBX is capable of handing high-speed data transmission. Too long a telephone line or too poor a PBX can cause annoying data transmission error (i.e., garbage).

PART III Commucications Software Configuration

(for both External and Internal Modems)

Most popular communications software packages will work well with your modem. You may, however prefer to purchase the recommended Bitcom™ commucications software package, which should be available from your dealer.

Turn on your computer first, then the modem. Boot the commucications software and check the following parameters:

1) The serial port number.
2) The communication speed and protocol.
3) Data format: data bit, stop bit, parity.

Set the serial port number to COM1, COM2, COM3 or COM4 according to which your modem is connected. Note that one port should be assigned to only one device; otherwise, the two devices will conflict with each other.

To use the modem to dial a remote modem, the speed and data format of both modems should be set to match each other. For example, if the bulletin board you are going to dial supports Bell 212A (1200 bps), 8 data bits, no parity, 1 stop bit; you should set your communications software to the same parameters.

Software configuration tips

If your computer is an IBM PC, XT, AT, 386, 486 or 586 and you are using Procomm™, Bitcom™, Crosstalk™ or most other communications software packages, the factory default settings of modem should be correct.

However, if you are using Smartcom™, the software requires that the DTR (Data Terminal Ready) always be forced ture. You should insert the command &D0 into the dialing prefix.

For PC-TALK™ or other software packages written in BASIC language, the CD signal should be forced true by inserting command &C0 in the dialing prefix of the software.

To use the terminal in manual operation, you should insert both commands &C0 and &D0. For exapmple, AT&0&D0DT.

To configure your modem for auto-answering, set register S0 to a non-zero value. For example, inserting S0=2 into the dialing instructs the modem to auto-answer incoming calls after the second ring.

To meet some special requirements, you may need to change some other parameters, such as the duplex mode, the auto line feed, the emulate, and so on. Consult an experienced modem user or your dealer for the required adjustments.

In addition, users outside of North America may want to have their modem set with the CCITT protocol as the default protocol. To do this, insert the command B0 into the dialing prefix in your software. For example, if the dialing prefix is ATDT, change it to ATB0DT.

The pulse telephone system in many European countries may require a different make/break ratio than that used in the United States. In such countries, insert the command &P1 into the dialing prefix in your software to select a ratio of 33/67. For example, if the dialing prefix is ATDP, change to AT&P1DP.

This modem also provides serveral different country's dialing method :
The &P2 command enables 33/67 make/break ratio @20pps.
The &P3 command enables 33/67 make/break ratio @10pps; Nine pulses mean digit 1 (for Newzwaland).
The &P4 command enable 33/67 make/break rato @10pps; Two pulses mean digit 1 (for Sweden).

Regrettably, we are unable to describle software configuration procedures in greater detail, as the provedures vary from software package to software package, from computer to computer, and f rom application. Refer to your software manual for more detailed information. If you have any difficulty, consult an experienced modem user or your dealer.

Speaker Volume Control

Through the built-in speaker, you can monitor the progress of modem calls. Speaker control and volume adjustment can be achieved by changing the corresponding selections in your communications software, or by issuing the appropriate commands to your modem.

The commands in related to speaker and volume control are:

M0 Speaker always off
M1 Speaker in until carrier detected
M2 Speaker always on
M3 Speaker on until carrier detected except when dialing

L0 Low volume
L1 Low volume
L2 Medium volume
L3 High volume

The default settings of your modem are in bold. To change the settings, include the appropriate commands in the Dial Prefix in the communications software. For example,

ATDT (original dial prefix)
ATM0DT Turn off speaker
ATM2L3DT Speaker always on, in high volume

Getting Started

Now boot the communications software and instruct it to dial a bulletin board, a data base, or remote computer with a modem. Your modem should proceed with the call and establish a connection automatically. Then you can:

1) Read or send electronic mail.
2) View the most updated news or information.
3) Upload or download computer programs.
4) Transmit or receive a text message or spread sheet data.
5) Play interactive games with the remote user.

With your modem completely installed, discover the fun and convenience of data communication.

Chapter 2 Operating the Modem

This chapter describes how to operate the modem after installing it. The modem has two operating modes: the Command Mode and the Data Mode.

1) The Command Mode lets you send instructions (commands) through the keyboard to the modem to perform a variety of functions.

2) The Data Mode lets you exchange data across the telephone line with a terminal or computer at remote location. In Data Mode, it assumes that everything it receives from your computer or terminal is data and sends it across the telephone line. Therefore, avoid typing a command while the modem is in Data Mode because the modem will handle the command as data and send it across the telephone line.

Entering the Command Mode

The modem automatically enters the Command Mode after:

1) You turn on the modem.

2) You lose the data connection with the remote modem -- which can occur when one modem fails to receive the carrier signal from the other modem. This can be intentional (such as when one modem hangs up) or unintentional (due to telephone line problems).

3) The &D1 command is in effect and the modem detects an on-to-off transition on the Data Terminal Ready (DTR) interchange circuit -- if this happens, the modem returns to the command mode without hang ing up. To hang up the modem, send the H command.

4) The &D2 command is in effect and the modem detects an on-to-off transition on the DTR interchange circuit -- if this happens, the modem hangs up and returns to the command mode.

5) The &D3 command is in effect and the modem detects an on-to-off transifion on the DTR interchange circuit -- if this happens, the modem hangs up, resets itself, obtains its operation parameters from its non-volatile memory and returns to the command mode. A complete description of the reset procedure appeares later in this chapter.

6) Touching any key on your computer keyboard while the modem is dialing -- if you touch any key on your computer keyboard while the modem is placing a call, the modem stops the call and hang up automatically.

Additionally, if you reset the modem when it's in the Command Mode, it remains in the Command Mode; however, any data connection with a remote modem is terminated.

Entering the Data Mode

The modem automatically enters the Data Mode after making a data connection with another modem at a remote location. The two modem make the data connection using a process called handshaking by sending high-pitched tones (called carrier tone) across the telephone lines.

Returing to the Command Mode and Keeping the Data Connection

When your modem is in the Data Mode, use the escape characters to return (or escape) to the Command Mode without losing the data connection. This feature is especially useful when you have established a data connection with a remote modem and want to check or change a setting of the modem and then return to data mode immediately.

The following procedure describes how to use the escape characters:

1) After the modem has made an asynchronous data connection, wait at least one second without typing anything.

2) Type the escape characters (default is +++).

3) Wait at least one second.

The modem then responds with either the word response OK or the number response 0 and enters the Command Mode while keeping the data connection. The modem continues to send the carrier signal and stays connected to the remote modem so long as the remote modem does not disconnect from the line or stop sending its carrier signal.

When you want to leave the Command Mode and return to data mode, perform the following procedure:

Type ATO or ATO1 or AT\O and then <CR>.

For ATO, the modem sends an appropriate connect response and returns to the data mode.

For ATO1, the modem sends an appropriate connect response and return to the data mode, and initiates an equalizer retrain.

For AT\O, the modem sends an appropriate connect response and proceeds to exchange data error-free with the remote MNP modem.

Register S2 sets the value of the escape characters. Register S12 defines how long you must wait both before and after typing the escape characters.

Note : If the &D2 command is in effect and you use the +++ characters to enter the Command Mode, an on-to-off transition the DTR interchange circuit has the same effect as the H command.

Resetting the Modem

There are three ways to reset the modem:

1) Sending a Z or Z1 command from your computer.
2) Sending a &D3 command then experiencing an on-to-off transition on the DTR interchange circuit.
3) Turning the modem off and then on.

Any of these reset methods causes the following actions to occur:

1) The modem uses the active configuration from its nonvolatile memory to set up its operating parameters. For more information about the non-

volatile memory, refer to chapter 8.

2) If the modem was off-hook, it goes on-hook (hangs up).
3) The last command executed by the modem is deleted from the modem's memory. This eliminates the usefulness of the A/ command.
4) The modem remains in the Command Mode.

> **Note :** Do not send any commands to the modem until at least onehalf second after resetting it.

Communication Modes

The modem supports both asynchronous and *synchronous communications. The requirements of the communication link, including the software that addresses the modem, determines the mode used. Most PC communications are performed in the asynchronous mode. Unless the modem is installed on a terminal(or a computer used as a terminal), connected to a mainframe, communication will most likely be asynchronous. Asynchronous transmission is different from synchronous transmission in the way data is grouped. Asynchronous transmission uses start and stop bits to indicate units of data; synchronous transmission uses clock pulses to frame blocks of data.

As the modem operates asynchronously, the modem must be configured for asynchronous use while attached to an asynchronous video display terminal (VDT) or to a computer with a VDT emulator. The &Q command is used to select the desired communication mode.

Asynchronous transmissions mode

Most communications are asynchronous. Asynchronous transmissions pass data between the modems as characters. Data is then transmitted as character bits framed by start, parity and stop bits to mark the beginning and end of character units.

The use of stop and parity bits is optionally depending upon the asynchronous character format selected.

The modem supports the following asynchronous character formats:

start bit	data bits	parity	stop bits
1	7	even/odd	1,2 or more
1	7	none	2
1	7	mark/space	1,2 or more
1	8	none	1,2 or more

The modem automatically adopts the parity setting of the attached data terminal until the next AT command is received,or until the modem is turned off.

In its factory configuration, the modem operates asynchronously, transmitting characters to and from the local data terminal and across the telephone line. If another mode has been selected, asynchronous mode can be reselected with the &Q0 command.

The diagram below illustrates how the modem operates in asynchronous mode.

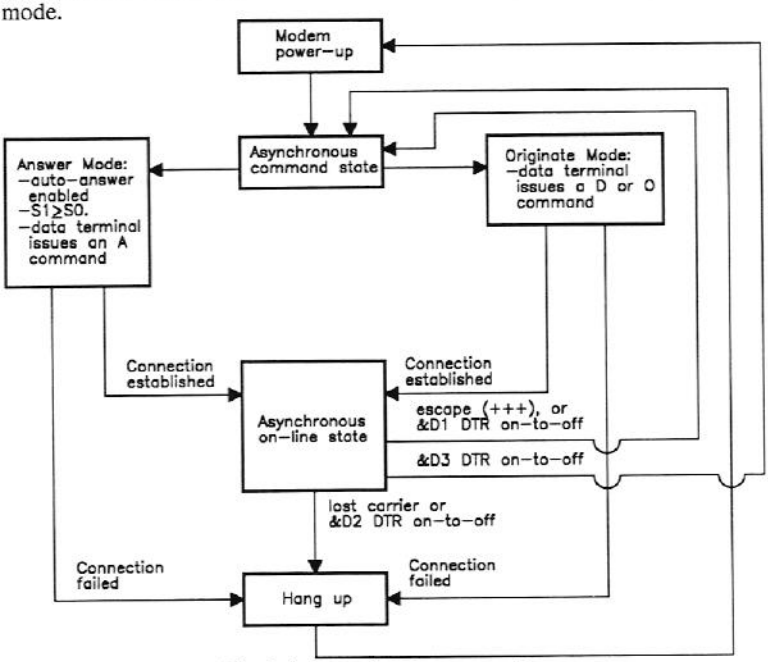


Fig. 2-1 asynchronous operation

The asynchronous mode supports both the on-line and the command states. When connected to an asynchronous VDT, the modem can be configured, used as a dialer, and placed on-line for data communications.

***Synchronous transmissions mode (for the external modem only)**

Synchronous communication is a specialized form of data transmission and generally requires special hardware and software combinations. When operating in a synchronous mode, the modem function as a pipeline, sending bits across the link according to uniform blocks of time.

Communications are managed through special protocols. Though techniques differ slightly, synchronous protocols assemble data in frames prior to transmission and disassemble the frames on arrival. If the communication environment supports synchronous communications, the framing-data formatting is performed by the communication software. No data format selection is required for the modem in synchronous mode.

In situations such as mainframe connections, the modem can be configured for synchronous modes. Synchronous communication requires special hardware and software that provides the necessary protocol of clock-oriented data transmission. The modem cannot be used in any of the three synchronous modes without special software that provides the necessary protocol of clock-oriented data transmission (For more information, refer to chapter 9).

Chapter 3 Command Line Syntax and Response Codes

This chapter describes the command line syntax as well as the standard response codes, the MNP extended response codes and the V.42bis/V.42 response codes. The V.42bis response codes are optionals for data compression models.

Issuing Commands

When the modem is in command state, you can issue commands through the keyboard. A command line begins with AT (or at), followed by the commands, and ended with the return key.

Some commands, such as Mn, Ln or &Dn, require an argument to follow the command letter.If the argument is missing, the modem will treat the argument as 0. For example, M would be equal to M0.

Multiple commands in a command line are allowed. You may insert spaces between commands to make it easier to read.

Command Buffer

The commands are stored in the command buffer. The command buffer has a capacity of 40 characters. The AT (or at), the carriage return, the optional line feed characters, as well as the spaces are not stored in the command buffer.

The command line will not be executed until you press the return key. If the command buffer overflows, the commands will be ignored and the modem sends the ERROR response code upon receiving the carriage return character.

Deleting Commands

If you made a mistake while typing a command line, press the backspace key to delete the last character you entered. The backspace key will not, however, delete the AT prefix.

To delete the whole command line, press the backspace key until every command character (except AT) is deleted. Then press the return key.

Standard Modem Response Codes

Unless you have issued command Q1, the modem sends a response code after executing a command line. The response code can be displayed in either word or digital form. The meaning of the codes are listed below. The number in the parenthesis is the digital equivalent of the response word.

OK (0)

The command line stored in the command buffer has been executed without errors.

CONNECT (1)

Modem has successfully established a connection with a remote modem at 300, 1200, 2400bps, 4800bps, 9600bps or 14400 bps (if command X0 was issued), or at 300 bps (if command X1, X2, X3, or X4 was issued).

RING (2)

Modem detects an incoming ring. The code RING is displayed on the screen repeatedly as each consecutive ring is detected until the modem goes off-hook.

NO CARRIER (3)

Modem has failed to detect a carrier within 30 seconds (determined by register S7) in a dialing or answering process, or modem detects loss of carrier when it is on-line with a remote modem, or is performing a local analog loopback test.

ERROR (4)

Modem has encountered an invalid command line, or the command buffer is overflowed (too many characters were entered into the command line).

CONNECT 1200 (5)

Modem has successfully established a connection with a remote modem at 1200 bps, enabled when command X1, X2, X3, or X4 was issued. This response is disabled by command X0 .

NO DIALTONE (6)

Modem has failed to detect a dial tone when instructed to wait for one before dialing (enabled by the dial modifier W, or by the command X2 or X4).

BUSY (7)

Modem has detected a busy signal after dialing a phone number (enabled by command X3 or X4, or by the dial modifier @).

NO ANSWER (8)

Modem has failed to detect a 5-second silence within the 30 second waiting period (determined by register S7) when dial modifier @ was issued.

CONNECT 2400 (10)

A connection has been established successfully at 2400 bps, enabled by command X1, X2, X3, or X4 , and disabled by command X0 .

MNP Response Codes

When &Q0 and \V1 is set, the modem will do the following extended responses:

CONNECT 300/REL (3R)

A connection has been established successfully at 300bps with reliable (MNP) data, enabled by command X1, X2, X3, or X4, and disabled by com-

mand X0.

CONNECT 1200/REL (12R)

A connection has been established successfully at 1200bps with reliable (MNP) data, enabled by command X1, X2, X3, or X4, and disabled by command X0.

CONNECT 2400/REL (24R)

A connection has been established successfully at 2400bps with reliable (MNP) data, enabled by command X1, X2, X3, or X4, and disabled by command X0.

CONNECT 4800/REL (48R)

A connection has been established successfully at 4800 bps with reliable (MNP) data, enabled by command X1, X2, X3, or X4, and disabled by command X0.

CONNECT 9600/REL (96R)

A connection has been established successfully at 9600 bps with reliable (MNP) data, enabled by command X1, X2, X3, or X4 and disabled by command X0.

CONNECT 14400/REL (144R)

A connection has been established successfully at 14400 bps with reliable (MNP) data, enabled by command X1, X2, X3, or X4, and disabled by command X0.

CONNECT 300/REL COMPRESSED (3C)

A connection has been established successfully at 300 bps with reliable compressed data, enabled by command X1, X2, X3, or X4, and disabled by command X0.

CONNECT 1200/REL COMPRESSED (12C)

A connection has been established successfully at 1200 bps with reliable compressed data, enabled by command X1, X2, X3 or X4, and disabled by

command X0.

CONNECT 2400/REL COMPRESSED (24C)

A connection has been established successfully at 2400 bps with reliable compressed data, enabled by command X1, X2, X3 or X4, and disabled by command X0.

CONNECT 4800/REL COMPRESSED (48C)

A connection has been established successfully at 4800 bps with reliable compressed data, enabled by command X1, X2, X3 or X4, and disabled by command X0.

CONNECT 9600/REL COMPRESSED (96C)

A connection has been established successfully at 9600 bps with reliable compressed data, enabled by command X1, X2, X3 or X4, and disabled by command X0.

CONNECT 14400/REL COMPRESSED (144C)

A connection has been established successfully at 14400 bps with reliable compressed data, enabled by command X1, X2, X3, or X4, and disabled by command X0.

V.42bis/V.42 Response Codes (optional for V.42 bis model only)

When &Q5 and W1 is set, the modem will do the following responses.

CONNECT 4800 (11)

Connection at 4800 bps (disabled by X0)

CONNECT 9600 (12)

Connection at 9600 bps (disabled by X0)

CONNECT 14400 (13)

Connection at 14400 bps (disabled by X0)

CONNECT 19200 (14)

Connection at 19200 bps (disabled by X0)

CONNECT 1200/75 (22)

Connection at 1200/75 bps (disabled by X0)

CONNECT 75/1200 (23)

Connection at 75/1200 bps (disabled by X0)

CONNECT 38400 (28)

Connection at 38400 bps (disabled by X0)

CONNECT 57600 (29)

Connection at 57600 bps (disabled by X0)

CARRIER 300 (40)

Modem detected 300 bps carrier signal from remote modem, and completed the standard modem handshaking procedure and entered the V.42 protocol handshaking procedure.

CARRIER 1200/75 (44)

Modem detected 1200/75 bps carrier signal from remote modem, and compIted the standard modem handshaking procedure and entered the V.42 protocol handshaking procedure.

CARRIER 75/1200 (45)

Modem detected 75/1200 bps carrier signal from remote modem, and compIted the standard modem handshaking procedure and entered the V.42 protocol handshaking procedure.

CARRIER 1200 (46)

Modem detected 1200 bps carrier signal from remote modem, and completed the standard modem handshaking procedure and entered the V.42 protocol handshaking procedure.

CARRIER 2400 (47)

Modem detected 2400 bps carrier signal from remote modem, and completed the standard modem handshaking procedure and entered the V.42 protocol handshaking procedure.

CARRIER 4800 (48)

Modem detected 4800 bps carrier signal from remote modem, and completed the standard modem handshaking procedure and entered the V.42 protocol handshaking procedure.

CARRIER 9600 (50)

Modem detected 9600 bps carrier signal from remote modem, and completed the standard modem handshaking procedure and entered the V.42 protocol handshaking procedure.

CARRIER 14400 (51)

Modem detected 14400 bps carrier singal from remote modem, and completed the standatd modem handshaking procedure and entered the V.42 protocol handshaking procedure.

COMPRESSION : CLASS 5 (66)

Modem completed MNP protocol handshaking with compressed data mode.

COMPRESSION : V.42 bis (67)

Modem completed V.42 bis protocol handshaking with compressed data mode.

COMPRESSION : NONE (69)

Modem completed V.42 protocol handshaking, but without compressed data mode.

PROTOCOL:NONE(70)

Modem made a connection without V.42 or MNP error correction protocol with a remote modem.

PROTOCOL : LAP-M (77)

Modem made a V.42 LAP-M protocol connection with a remote modem and is entering data mode.

PROTOCOL : ALT (80)

Modem made a connection with MNP protocol but without V.42 protocol with a remote modem.

Chapter 4 Commands

This chapter summaries three groups of commands: the standard "AT" commands, MNP extended commands and V.42bis/V.42 commands.

Standard "AT" Commands

The following summaries the standard "AT" commands to configure and control the modem. Factory settings are indicated by boldfacing.

AT	Command prefix - precedes command line
<CR>	Carriage return character, terminates command line
A	Go off-hook, remain in command state (Answer incomming calls)
A/	Re-execute previous command line; not preceded with AT nor followed by <CR>
B0	CCITT V.32 bis/V.32/V.22bis/V.22/V.21 compatibility
B1	Bell 212A/103 compatiblity
B2	CCITT V.23 compatibility only (recommanded DTE speed is fixed at 1200 bps)
D	Go into originate mode (dial calls); attempt to go to on line state. The following modifiers can be used after the D command:

0-9, A, B, C, D, #, *	(Telephone numbers, access codes)
P	pulse dial (factory setting)
T	tone dial
,	delay processing of next character (pause)
!	hookflash
@	wait for silence
W	wait for dial tone
;	return to command state after dialing
R	reverse mode (to call an originate-only modem)

DS=n Dials one of the three telephone numbers stored in the modem's non-volatile memory (n = 0, 1, 2)

+++ Switch from Data Mode to Command Mode; pause one second before typing; do not follow with carriage return (see Registers S2 and S12)

E0 Disable character echo in command state
E1 Enable character echo in command state

H0 Go on-hook (hang up)
H1 Go off-hook

I0 Display product identification code; display 3-digit code.
I1 Display checksum on firmware ROM; return 3-digit checksum
I2 Compare checksum on firmware ROM; returns OK or ERROR response codes
I3 V.42 / MNP identification code
I4 Modem chip identification code

L0 Low speaker volume
L1 Low speaker volume
L2 Medium speaker volume
L3 High speaker volume

M0 Speaker off
M1 Speaker on until carrier detected
M2 Speaker always on
M3 Speaker on until carrier detected, except during dialing

O0 Go to on-line state (Data Mode)
O1 Go to on-line state and initiate equalizer retrain

Q0 Return response codes
Q1 Do not return response codes

Sr=n Set register "r" to value "n" (r=0-27, 36, 46, 48, 82, 95; n=0-255)
Sr? Display value stored in register "r" (r=0-27, 36, 48, 82, 95)

V0 Display response codes in numeric form
V1 Display response codes in verbose form (as words)

X0 Hayes Smartmodem 300 compatiblity

X1 Include CONNECT 1200 and CONNECT 2400 responses, connect 4800, connect 9600, connect 19200 disable dial tone detection and busy tone detection

X2 Same as X1 and include dial tone detection response, disable blind diaing and busy tone detection

X3 Same as X1 and include busy signal detection response

X4 Same as X1 and include both dial tone and busy signal detection responses

Y0 Do not sent or respond to break signals (Long space disconnect disabled)

Y1 Send break signal wait for 4 seconds before disconnection, and after receving break signal wait for 1.6 seconds before disconnection

Z0 Reset, perform self-test for 2 seconds, and retrieve active configuration profile 0

Z1 Reset and retrieve active configuration profile 1

&C0 Data carrier detect always present (DCD always on)

&C1 Track presence of data carrier (DCD is on when there is carrier)

&D0 Ignore DTR signal

&D1 Enter command state when an on-to-off transition of DTR occurs

&D2 Hang up and enter command state when an on-to-off transition of DTR occurs

&D3 Reset when an on-to-off transition of DTR occurs

&F0 Recall factory settings as active configuration (Standard Hayes compatible)

&F1 Recall factory settings as active configuration (Enable MNP5 opera tion)

&G0 No guard tone

&G1 Use 550 Hz guard tone

&G2 Use 1800 Hz guard tone

&J0 Use RJ-11/RJ-41S/RJ-45S telephone jack

&J1 Use RJ-12/RJ-13 telephone jack

&L0 Set up for dial-up line operation

&L1 Set up for leased line operation

&P0 Pulse dial make/break ratio = 39/61 (for North America)
&P1 Pulse dial make/break ratio = 33/67 (for UK and HK)
&P2 33 / 67 make/break ratio @20pps
&P3 33 / 67 make/break ratio @10pps; Nine-pulse mean digit 1 (for Newzealand)
&P4 33 / 67 make/ break ratio @10pps; Two-pulse mean digit 1 (for Sweden)

&Q0 Configured for asynchronous operation, and also for MNP operation.
*&Q1 Enter synchronous mode after dialing asynchronous (external modem only)
*&Q2 Synchronous terminal support only (for external modem only)
*&Q3 Manually originating a synchronous call (for external modem only)
&Q5 Configured for V.42/V.42 bis operation

&R0 Track CTS according to RTS
&R1 Ignore RTS, CTS always active

&S0 Assume presence of DSR signal
&S1 Track presence of DSR signal

&T0 Terminate test in progress
&T1 Initiate local analog loopback test
&T3 Initiate local digital loopback test
&T4 Grant request from remote modem for remote digital loopback test
&T5 Deny request from remote modem for remote digital loopback test
&T6 Initiate remote digital loopback test

&V Display active configuration profile and configuration profile 0 and 1, and stored telephone number

&W0 Store active configuration profile as configuration profile 0
&W1 Store active configuration profile as configuration profile 1

&X0 Modem provides transmit clock signal
&X1 Data terminal provides transmit clock signal
&X2 Receive carrier provides transmit clock signal

&Y0 Configuration profile 0 will be the active configuration profile after power on or reset
&Y1 Configuration profile 1 will be the active configuration profile after power on or reset

*** For the External Modem only**

&Zn= Stores up to three telephone numbers in the nonvolatile memory. Use DS=n to dial the number (n = 0,1,2)

%P0 Disable Power-on automatically leased line or calling a telephone number
%P1 Power-on automatically leased line or calling a telephone number

%S0 Call back security disabled
%S1 Call back security enabled

MNP Extended Commands

The modem comes with the Microcom Networking Protocol (MNP) error detection/correction capability.When the error control mode is enabled, and if the remote modem also supports MNP, this protocol ensures error free data transmission. However, if the received signal becomes unrecognizable, a re-train will occur which causes the two modems to re-handshake and train to the new line condition. the MNP protocol has become the standard for the asynchronous dial-up modem industry, thus many modem suppliers do support this scheme.
In error control mode, data is formed into packets and transmitted with a CRC (Checksum). The remote modem calculates its own CRC while receiving the packet and then compares that value to the received CRC. If the two values match then the data was transmitted without error, otherwise a negative acknowledgement is sent back to transmit modem to retransmit the packet again.

Microcom networking protocol

The Microcom Networking Protocol is an asynchronous error detection/ correction protocol designed to work in a variety of environments. There are several classes of MNP established. They are:

1) Asynchronous half duplex
2) Asynchronous full duplex
3) Synchronous between modems, full duplex (for external modem only)
4) Adaptive packet assembly
5) Data compression

Once the physical link has been established between two modems (handshake complete), they will negotiate which class to be used for the error control, in

addition to frame size etc. Classes 3 and above will achieve higher throughput than the connection data rate. Whenever error control is enabled, either CTS or XON/XOFF flow control should be used.

Data compression

The modem improves system throughput by data compression. MNP classes 3 and 4 improve the throughput by deleting the transmission of start, stop bit and the block length according to the line conditions.

In MNP class 5 operation, a data compression algorithm is used to enable the modem to send fewer bits for the same message. By using a lookup table, the modem learns to adjust the data transmitted, and then eliminates unnecessary bits before transmission. The receiving modem then restores the data before sending it to the DTE device.

Although the MNP will enhance the throughput of your modem, but the compression ratio is dependent upon the type of data being transmitted. The exact speed is not fixed. It varies from file to file.

Speed conversion

The modem provides a DTE speed conversion feature for your computer or terminal that allows fixed speed data transfer. By using flow control, the modem will properly buffer or "pack" the flow of data between the modem and DTE. This means that the terminal or computer can be set at 57600 bps and the speed of the data link over the telephone line can be 300, 1200, 2400 bps, 4800 bps, 9600 bps or 14400 bps. The modem will then send the data to the DTE in bursts at a rate of 57600 bps.

This feature is commonly used in MNP class 5 applications when the net speed over the telephone link is changing.The modem will use flow control to send data at 57600 bps to the DTE, then send no data while it fills up its buffer, then send again.

Note : To enter MNP mode operation, use \N2 command. To exit MNP mode, use \N0 command.

Follwoing table lists alphabetically the MNP commands, the range of possible selections and the default values available to the modem.

%An Set auto-reliable fall back character to n (n = 0 - 127), Requires the

\C2 setting, which is the default

\A0 64-character maximum MNP block size

\A1 128-character maximum MNP block size

\A2 192-character maximum MNP block size

\A3 256-character maximum MNP block size

\Bn Send a n/10 second line break to the modem (n = 1 - 9), Default is 3

%C0 Disable MNP class 5 operation

%C1 Enable MNP class 5 operation

\C0 Do not buffer data

\C1 Buffer all data for 4 seconds, until receiving 200 characters or until a packet is detected

\C2 Do not buffer data switch to normal mode when fall back character is detected

\E0 Do not echo data during a normal link

\E1 Echo data during a normal link

\H0 HP ENQ/ACK protocol disable

\H1 HP ENQ/ACK protocol enable, act as a modem connect to host

\H2 HP ENQ/ACK protocol enable, act as a modem connect to a peripheral

\G0 Disable DCE flow control

\G1 Enable DCE flow control

> **Note :** The reliable link has its own method of flow control and ignores the AT\G setting

\J0 Turn off DTE baud rate adjustment

\J1 Turn on DTE baud rate adjustment

\Kn Sets the Break control, as follows:
Break sent to the serial port, modem is in CONNECT state during a reliable or normal connection:

AT\Kn Function

n = 0,2,4 Enter the Command Mode, but do not send a Break to the

remote modem. (To send a Break after use the \B command)

n = 1 Empty data buffers and immediately send a Break.
n = 3 Immediately send a Break.
n = 5 Send a Break in sequence with any data received from the port.

Transmit Break command sent, modem is in Command Mode during a reliable or normal connection:

AT\Kn	Function
n = 0,1	Empty data buffers and immediately send a Break to the remote modem.
n = 2,3	Immediately send a Break.
n = 4,5	Send a Break in sequence with any data buffered.

Break sent to the serial port, modem is in CONNECT state during a direct connection:

AT\Kn	Function
n = 0,2,4	Immediately send a Break and place the modem into the Command Mode after the Break is sent through.
n = 1,3,5	Immediately send a Break through.

\N0 Normal data-link only (to exit from MNP mode operation)
\N1 Direct data-link only
\N2 Reliable link only (to enter MNP mode operation)
\N3 Auto-reliable link

\O Initiate reliable link during a normal link

\Q0 Turn off software flow control
\Q1 XON\XOFF software flow control
\Q2 CTS signal unidirectional hardware flow control
\Q3 RTS\CTS signal bidirectional hardware flow control
\Tn Inactivity timer: n seconds (n = 0 - 90), Default is 0

\U Accept reliable link during a normal link

\V0 Do not send MNP extended responses

\V1 Send MNP extended responses

\X0 Process XON\XOFF and don't pass through
\X1 Process XON\XOFF and pass through

\Y Switch to reliable link from normal link

\Z End the reliable connection and switch to normal (non-MNP) operation

V.42 bis/V.42 Extended Commands

The CCITT V.42 bis/V.42 specification is an international standard, adopted in November 1988, for point-to-point modem error control. V.42 bis/V.42 designates LAP-M (Link Access Procedure for Modems) as the primary point-to-point error control protocol.

V.42 bis/V.42 supports two methods of error correction: LAP-M and, as a fallback, MNP2-4. The modem offers a negotiation technique for determining and establishing the best method of error correction between two modems. This technique involves two phases: detection and negotiation. In the detection phase, which occurs immediately after the establishment of the modem handshake, the communicating modems exchange a sequence of detection patterns to verify that both sides support the error correction technique. In the negotiation phase, the communicating modems exchange configuration information. If the detection phase fails, or negotiation does not achieve the desired connection type, the modem can hang up, fallback to MNP, or fallback to a standard asynchronous mode. Desired action to make is selected with register S36. Since MNP does not support a detection phase, the selection of MNP 4 must be made as a forces fallback with registers S48 and S36.

The following S registers are used for V.42 LAP-M operation:

S36...V.42 negotiation fallback
S46...Protocol selection (For V.42 bis model only)
S48...V.42 negotiation action
S82...Break handling
S86...Connection failure cause code

Enabling V.42 operation

Note : To enter V.42 mode operation, use &Q5 command. To exit V.42 mode, use &Q0 command.

Type AT&Q5<CR>, the modem responds with OK and will attempt to make all subsquent connections using the V.42 standard.

Register S46 will define the protocol selection and Register S48 will define the feature negotiation process used by the modem.

The following table shows the protocol that will be used when local modem receives the &Q5 command and then tries to make a connection with remote modem.

Local V.42 modem	**Remote modem**	**Communications protocol used**
&Q5 command is in effect	Hayes V-series modem	LAP-M at 1200, 2400, 9600 and 14400 bps
&Q5 command is in effect	V.42 modem	LAP-M
&Q5 command is in effect	MNP modem	Alternative protocol#

If the V.42 modem connects to a remote MNP modem, the V.42 modem first attempts an MNP Class 5 or Class 4 connection, If this fails, an MNP Class 2 or Class 3 connection will be attempted.

Disabling V.42 operation

Type AT&Q0 <CR>, the modem responds with OK and returns to asynchronous operation.

Note : Alternatively the command &Q1, &Q2, &Q3, can be used in place of &Q0 to switch to one of the modem's syschronous operation mode (refer to the standard commands chapter).

V.42 commands

W0 Disable V.42 extended responses
W1 Enable V.42 extended responses

&K0 Local flow control disabled
&K3 RTS/CTS signal bidirectional hardware flow control
&K4 XON/XOFF software flow control
&K5 Transparent XON/XOFF software flow control

&Q5 Instructs the modem to make a data connection using the V.42 standard.

Chapter 5 Modem's S-registers

This chapter describes definitions, parameters, and factory-set values for the modem's S-registers. These registers are used by the modem to hold configuration and operation parameters. Techniques for reading from and writing to these registers are discussed.

Parameter values referred to as factory-set are those held in the modem's ROM as part of the modem's factory configuration. Setting an S-register to a value outside the ranges specified is permitted, but not recommended.

S-register Configuration

S-registers provide special access to modem configuration. For the knowledgeable user, these registers offer advanced techniques for controlling the operations of the modem.

The value of each S-register is expressed as an ASCII character string, a timing parameter, or a counter.

Reading an S-register Value - Sr?

The command to read an S-register value is Sr? (where "r" is the number of the register). For example, ATS0?<CR> reads the value of S-register 0. If this command were issued to a modem with the factory settings as the active configuration, the modem would return the value 000. A three-digit sequence is returned for each register read representing an ASCII character string.

Several S-registers can be read at once by including them on the same command line. For example, ATS2?S4?S7?<CR> reads the values of three registers and returns the values 043, 010, 030.

Changing an S-register Value - Sr=n

The command to change an S-register value is Sr=n(where "r" is the number of the register and "n" is the assigned value). for example, ATS0=1 <CR> changes the value of S-register 0 from its factory setting to 1, which enables auto-answer. This new value is stored and used until the modem is turned off or reset. Values written to registers S0, S7, S9, S10, S18, and S25 are written to nonvolatile memory if the active configuration is saved with the &W command. The saved value for the register(s) will be recalled when the modem is reset.

Addressing an S-register - Sr

You can set a pointer to a particular S-register with Sr (where "r"is the number of the register). For example, ATS7 <CR> sets a pointer to S-register 7. Until another register is specified, the value of S-register 7 can be read with AT? <CR> and changed with AT=n <CR>.

Standard Registers

Register S0 - ring to answer on

S0 sets the number of rings on which the modem automatically answers in auto-answer mode. Setting S0=0 disables auto-answer. The range for the register is 0-255 rings with a factory setting of 1.

Register S1 - ring count

The modem automatically tracks the number of times the phone rings, incrementing and writing the value in S1. The value of the register reverts to 0 if no ring occurs for an 8 second interval. The range for this register is 0-255 rings with a factory setting of 0.

Register S2 - escape sequence character

S2 holds the ASCII value of the escape sequence character. The factory-set value is ASCII 43, the plus sign (+). The value for this register can be set to any value between 0 and 127. Setting S2 to a value greater than 127 disables the escape sequence thus prevents the modem from returning to the command state and disables command recognition.

Register S3 - carriage return character

S3 holds the ASCII value of the carriage return (<CR>) character. The factory-set value is ASCII 13. The range for the register is 0-127. This character is used both as the command line terminator and the result code terminator.

Register S4 - line feed character

S4 holds the ASCII value of the line feed character. The factory- set value is ASCII 10. The range for the register is 0-127.

Register S5 - backspace character

S5 holds the ASCII value of the backspace character. The factory-set value is ASCII 08; the range for the register is 0-127. This character is used for cursor movement to the left and to remove the previous character. As this value actually represents the combined operation of three characters (a backspace, a space, and another backsapce), the time allowed to process this backspace character must not be less than the time required by the modem to transmit three character. For this reason, a repeat-key function may not operate properly on backspaces.

Register S6 - wait time before blind dialing

The value in S6 determines how long the modem waits after picking up the telephone before it dials. This delay allows time for the central telephone office to detect the off-hook condition of the line and to apply a dial tone. The value in S6 is used when the X0, X1, or X3 commands are in effect. X2 and X4 enable dial tone detection and disable blind dialing, making the value in S6 irrelevant. The factory setting for the register is 2 seconds. The value can be set to a value between 2 and 255 seconds.

Register S7 - wait time for carrier/dial tone

This register serves two functions. During call establishment, the value in S7 determines the modem's waiting time between dialing and incoming carrier signal. If the modem does not detect a carrier within this time, it hangs up and returns the NO CARRIER response code. If the modem detects a carrier within the specified time, it goes on line. This value in S7 also determines the duration of the pause generated by the W dial modifier.

If too big a S7 value is used to extend the wait time for carrier detection and a W dial modifier is also included in the dialing string, the delay produced by the W modifier may cause a timing error. This is because some telephone company will stop the progress of a call if no dial tone is defected within a certain amount of time, regard less of S7 setting.

The factory setting for this register is 30 seconds with a range of 1 to 255 seconds.

Register S8 - duration of delay for comma dial modifier

S8 determines the duration of the pause generated by the comma (,) dial modifier. The factory-set value is 2 seconds. The range is 0 to 255 seconds.

Register S9 - carrier detect response time

S9 determines how many seconds a carrier signal must be present for the modem to recognize it and issue a carrier detect. This feature prevents a ring or a busy signal from being mistaken as a carrier. The value for the register is meausred in tenths of a second. The factory setting is 6 (.6 second). The range is 1 (.1 second) to 255 (25.5 seconds).

Register S10 - delay between lost carrier and hang up

S10 specifies the time between loss of remote carrier and local modem hangs up. The delay permits the carrier to disappear momentarily without causing the modem to hang up. The value for the register is measured in tenths of a secocnd. The factory setting is 14 (1.4 second). The range is 1 (.1 second) to 255 (25.5 seconds).

The modem recognizes a carrier after the period of time specified in S9. Therefore, if the value of S10 is less than that set for S9, even a momentary loss of carrier will cause the modem to disconnect. Setting the register to 255 causes the modem to ignore actual carrier status and assume a carrier is always present.

Register S11 - DTMF tone duration

The value of S11 determines the duration and spacing of tones in Dual Tone Multifrequency (DTMF) dialing. The factory-set value is 95 milliseconds. The range is 50 milliseconds to 255 milliseconds. The value in this register has no effect on the speed of pulse dialing, which is fixed for 10 pulses per second.

Register S12 - escape sequence guard time

S12 holds the value of the delay required prior to and following the escape sequence. The guard time also dictates how quickly the escape sequence characters must be entered, since the interval between entry of each of the three characters must be of shorter duration than that specified for the guard time.

The factory-set value is 50 (one second). The range is 0 to 5.1 seconds (set in 20 millisecond increments from 20 to 255). If the guard time is set to 0, timing is not a factor.

Register S13 - reserved

Register S14 - echo, response, dial method, and originate/answer

Bit-mapped register S14 lets you control modem echo, responses, dialing method, and the originate or answer mode.

Bit		Function
0 =	0	Disable V.42 extended responses (W0)
	1	Enable V.42 extended response (W1) -- default
1 =	0	Do not echo command characters (E0)
	1	Echo command characters (E1) -- default
2 =	0	Response codes appear (Q0) -- default
	1	Response codes do not appear (Q1)
3 =	0	Responses codes appear as digit (V0)
	1	Responses codes appear as words (V1) – default
4 =	0	Modem strapped smart -- default
	1	Modem strapped dumb
5 =	0	Use Touch-Tone dialing method (T) -- default
	1	Use pulse dialing method (P)
6 =	0	Use profile 0 as active configuration when power on (&Y0) -- default
	1	Use profile 1 as active configuration when power on (&Y1)

7 = 0 Answer incoming calls (A)
1 Originate (dial) calls (D) -- default

Register S15 - reserved

Register S16 - modem tests

Bit-mapped Register S16 lets you perform the following tests with your modem:

Bit		Function
0 =	0	Local analog loopback test off (&T0) -- default
	1	Local analog loopback test on (&T1)
1		Undefined
2 =	0	Local digital loopback test off (&T0) -- default
	1	Local digital loopback test on (&T3)
3 =	0	Disable remote digital loopback test (&T0) -- default
	1	Enable remote digital loopback test (&T6)
4 =	0	Local modem grant RDL request from remote system (&T4) -- default
	1	Local modem deny RDL request from remote system (&T5)
5 =	0	Do not perform remote digital loopback test and self-test (&T0) -- default
	1	Perform remote digital loopback test and self-test (&T7)
6 =	0	Do not perform local analog loopback test and self-test (&T6) -- default
	1	Perform local analog loopback test and self-test (&T8)
7		Undefined

Register S17 - reserved

Register S18 - modem test timer

S18 establishes the duration of the modem's diagnostic tests. When a test is

active for a length of time equal to the value of S18, the modem automatically terminates the test. A setting of zero(0) disables the test timer. The range for this register is 0-255 seconds with a factory setting of 0.

Register S19 - reserved

Register S20 - reserved

Register S21 - jack type, Clear To Send, Data Terminal Ready, and Long Space Disconnect

Bit-mapped Register S21 lets you control the jack type and certain data communication control signals.

Bit		Function
0 =	0	RJ-11, RJ-14S, RJ-45S jack type (&J0) -- default
	1	RJ-12, RJ-13 jack type (&J1)
1 =	0	Set up for dial-up line operation (&L0) -- default
	1	Set up for leased line operation (&L1)
2 =	0	Clear To Send on until modem goes off-hook: Request To Send off-to-on transition turns on Clear To Send; it goes off again after Request To Send on-to-off transition (&R0) -- default
	1	Clear To Send on until modem goes off-hook; Clear To Send goes on when data connection is made and goes off with loss of the remote carrier signal (&R1)
3,4 =	0	Ignores the Data Terminal Ready signal (&D0)
	1	Enters Command Mode after Data Terminal Ready on-to-off transition occurs (&D1)
	2	Hangs up and enter command mode after on-to-off of DTR occurs (&D2) -- default
	3	Resets after DTR on-to-off (&D3)
5 =	0	Carrier Detect signal always on (&C0)
	1	Carrier Detect signal on when a remote carrier signal is present (&C1) -- default

6 =	0	Assume Data Set Ready always on (&S0) -- default
	1	Data Set Ready to operate in accordance with EIA RS-232C specification (&S1)
7 =	0	Long Space Disconnect turned off (Y0) -- default
	1	Long Space Disconnect turned on (Y1)

Register S22 - speaker and responses

Bit-mapped Register S22 lets you control the modem's internal speaker and the responses it returns.

Bit		Function
0,1 =	0	Low speaker volume (L0)
	1	Low speaker volume (L1)
	2	Medium speaker volume (L2) -- default
	3	Loud speaker volume (L3)
2,3 =	0	Speaker off (M0)
	1	Speaker on until carrier detected (M1) -- default
	2	Speaker always on (M2)
	3	Speaker on until carrier detected, but speaker off during dialing (M3)
4,5,6 =	0	Hayes smartmodem 300 compatibility (X0)
	4	Include CONNECT 1200 and CONNECT 2400, 4800, 9600, 14400 responses (X1)
	5	Same as 4 plus dial tone detection (X2)
	6	Same as 4 plus BUSY response (X3)
	7	Same as 6 plus NO DIALTONE response (X4) -- default
7		Undefined

Register S23 - remote digital loopback request, data rate, parity, and guard tone

Bit-mapped Register S23 lets you control the modem's honoring of a Remote Digital Loopback Test request from a remote modem, data rate, parity, and guard tone.

Bit		Function
3,2,1,0 =	0	Terminal uses 110 bps data rate
	1	Terminal uses 300 bps data rate
	2	Terminal uses 600 bps data rate
	3	Terminal uses 1200 bps data rate
	4	Terminal uses 2400 bps data rate
	5	Terminal uses 4800 bps data rate
	6	Terminal uses 9600 bps data rate
	7	Terminal uses 14400 bps data rate
	8	Terminal uses 19200 bps data rate
	9	Terminal uses 38400 bps data rate
	10	Terminal uses 57600 bps data rate
4,5 =	0	Terminal uses space parity -- default
	1	Terminal uses even parity
	2	Terminal uses odd parity
	3	Terminal uses mark or none parity
6,7 =	0	Turn off guard tones (&G0) -- default
	1	Use 550 Hz guard tone(&G1)
	2	Use 1800 Hz guard tone (&G2)
	3	Reserved

Register S24 - reserved

***Register S25 - DTR detection delay (for the external modem only)**

In synchronous mode 1, this register is used to specify the time the modem waits after a connection is made, but before the modem examines DTR. This delay gives the user sufficient time to disconnect the modem from the asynchronous terminal and then connect to a synchronous terminal without forcing the modem back to the command state. The factory-set value for S25 is .05 seconds. The range is 0-255 in 1/100 seconds.

In any mode, a change in DTR (to on or off) that persists for a period shorter than the value stored in S25 is ignored by the modem while it is on-line.

Register S26 - RTS to CTS delay

This register is used to specify the time to delay between an off-to-on transition of RTS and turning on CTS. This value takes effect when the &R0

command option is selected. This setting applies to synchronous modes 1, 2, and 3 only. The factory-set value is 1 (.01 seconds), with a range of 0-255.

Register S27 - asynchronous/synchronous operation

Bit-mapped Register S27 lets you control the modem's transmission mode and line type.

Bit		Function
3,1,0 =	0	Use asynchronous operation (&Q0) -- default
	*1	Enter synchronous mode after dialing asynchronous (&Q1)
	*2	Synchronous terminal support (&Q2)
	*3	Manually originating a synchronous call (&Q3)
	5	Use V.42/V.42bis protocol mode (&Q5)
4,5 =	*0	Modem provides the synchronous transmit clock on EIA RS-232C pin 15 (&X0) -- default
	*1	Modem accepts an externally provides synchronous clock, from the acttached DTE on EIA pin 24, and provided synchronous clock from the Carrier Detect signal being received and provided the clock on EIA pin 15
7,6,2=	0	Use 110 bps line speed
	1	Use 300 bps line speed
	2	Use 600 bps line speed
	3	Use 1200 bps line speed
	4	Use 2400 bps line speed
	5	Use 4800 bps line speed
	6	Use 9600 bps line speed
	7	Use 14400 bps line speed -- default

Register S28 - enhanced modem's function

Bit		Function
0 =	0	Disable power-on automatically leased-line or calling a telephone number (%P0) -- default
	1	Power-on automatically leased-line or calling a telephone number (%P1)
1		Undefined

*** For the External Modem only**

2 = 0 Call back security disable (%S0) -- default
1 Call back security enable (%S1)

4, 5 = 0 CCITT V.22 bis/V.22/V.21 (B0) -- default
1 Bell 212A/103 (B1)
2 CCITT V.23 (operat 1200 bps only) (B2)

MNP Registers

The following registers are for valid MNP operation only. (&Q0)

Register S36 - link mode, flow control

Register S36 is a bit-mapped register and provides the following MNP functions (equivalent commands are show in parentheses):

Bit		Function
1,0 =	0	Standard (non-MNP) data link only (\N0) (to exit from MNP operation)
	1	Direct data link only (\N1)-Factory setting -- default
	2	Reliable (MNP) link only (\N2) (to enter MNP operation)
	3	Auto-reliable link (\N3)
5,2 =	0	Disable DCE flow control (\G0)
	1	Enable DCE flow control (\G1) -- default
	2	Enable DCE transparent flow control (\G2)
3 =	0	Process XON/XOFF characters, don't pass through (\X0) -- default
	1	Process XON/XOFF characters, and pass through (\X1)
4		Reserved
7,6=	0	Turn off software flow control (\Q0) -- default
	1	Turn on XON/XOFF software flow control (\Q1)
	2	CTS signal unidirectional hardware flow control(\Q2)
	3	RTS/CTS signal bidirectional hardware folw control(Q3)

Register S37 - auto-reliable fallback character

Register S37 defines the auto-reliable fallback character used to tell the modem to return form reliable (MNP) mode to a standard connection. This register can be set to a decimal value between 0 and 127. Values greater than 127 will be equivalent to zero.

Register S38 - echo data, buffer data, response, HP protocol

Register S38 is a bit-mapped register and provides the following test funictions (equivalent commands are shown in parentheses):

Bit		Function
1,0 =	0	Do not buffer data (\C0) -- default
	1	Buffer data for 4 seconds unit 200 characters received or until 200 a packet is detected (\C1)
	2	Do not buffer data, switch to standard operation when fall back character is received (\C2)
2 =	0	Turn off DTE baud rate adjustment (\J0)
	1	Turn on DTE baud rate adjustment (\J1) -- default
3 =	0	Don't echo data during normal link (\E0) -- default
	1	Echo data during normal link (\E1)
4 =	0	MNP responses disabled (\V0) -- default
	1	MNP responses enabled (\V1)
5,6 =	0	HP ENQ/ACK protocol disable (\H0) -- default
	1	HP ENQ/ACK protocol enable act as a modem connect to HOST (\H1)
	2	HP ENQ/ACK protocol enable act as a modem connect to a peripheral(\H2)
7		Reserved

Register S39 - inactivity timer

Register S39 corresponds to the MNP inactivity timer. If no data activity occurs for a period of time defined by this register, the modem disconnects from the remote MNP modem automatically(\Tn). Default value of n is 000.

Register S40 - block size, break control

Register S40 is a bit-mapped register and provides the following MNP functions (equivalent commands are shown in parentheses):

Bit		Function
1,0 =	0	64-character maximum MNP block (\A0)
	1	128-character maximum MNP block (\A1)
	2	192-character maximum MNP block (\A2)
	3	256-character maximum MNP block (\A3) -- default
4,3,2		Reserved
7,6,5 =	0	See the \K0 command
	1	See the \K1 command
	2	See the \K2 command
	3	See the \K3 command
	4	See the \K4 command
	5	See the \K5 command -- default

Register S41 - compression control

Register S41 is a bit-mapped register and provides the following MNP functions (equivalent commands are shown in parentheses):

Bit		Function
0 =	0	Disable MNP Class 5 operation (%C0) -- default
	1	Enable MNP Class 5 operation (%C1)
2-7		Reserved

V.42 bis / V.42 Registers

The following registers are valid for V.42 operation only.(activeated by &Q5)

Register S36 - V.42 negotiation fallback

Register S36 defines the type of connection attempted by the modem and the action to take if the attempt fails:

Bit	Function
2,1,0 = 0	Modem hangs up
1	Same as 5
2	Reserved
3	Same as 7
4	Modem tries to connect using V.42 Alternative Protocol (compatible with MNP levels 2-5). If handshaking fails modem hang up.
5	Modem tries to connect using V.42 Alternative Protocol (compatible with MNP levels 2-5). If handshaking fails, modem tries to connect using a standard asynchronous connection -- default
6	Reserved
7	Modem tries to connect using V.42 Alternative Protocol (compatible with MNP levels 2-5). If handshaking fails, modem tries to connect using a standard asynchronous connection and automatic speed buffering.

Register S46 - protocol selection

Register S46 defines the protocol selections specified for future negotiation.

	Function
136	LAP-M only
138	LAP-M with adaptive data compression -- default

Register S48-V.42 negotiation action

Register S48 defines whether feature-negotiation is to be performed by the modem. The feature-negotiation process allows the modem to ascertain the remote system's capabilites. If these capabilities are already know and negtiation is not necessary, this feature can be bypassed.

	Function
0	Negotiation disabled, local modem assumes the remote modem is configured properly to make a connection, bypasses the detection and negotiation phases.
3	Same as 7
7	Negotiation enabled. -- default
128	Negotiation disabled. Forces immediate fallback as specified in Register

Note : S36 can be used to force the V.42 alternative protocol (compatible with MNP), bypassing the detection and negotiation phases.

Register S82 - break handling

Register S82 specifies the break signal method used during V.42 applications. The break type to be used depends on the user application.

	Function
3	Expedited break signalling, regardless of its sequence in data sent and received by each modem. Data integrity is maintained both ahead of and after the break.
7	Destructive break signalling, regardlles of its sequence in data sent and received by each modem. Data being processed by each modem at time of break is discarded.
128	In sequence break signalling as data is sent and received. Data integrity is maintained both ahead of and after the break.

Register S86 - connection failure cause code

Register S86 helps to detremine the reason for a failed connection following a NO CARRIER response. When the modem sends this response, a value is written to this register. If multiple NO CARRIER responses are received, this register records the first event that occurred.

	Function
0	Normal hangup, no error occurred.
1,2,3	Reserved
4	Physical carrier loss.
5	Feature negotiation failed to detect a remote error control modem.
6	Remote error-control modem did not respond to feature negotiation message sent by this modem.
7	Remote modem is synchronous only, local modem is asynchronous only.
8	Modems could not find a common framing technique (asynchronous/synchronous)
9	Modems could not find a commom protocol.
10	Feature negotiation message sent by remote modem is incorrect.
11	Synchronous information (data or flags) not received from remote modem. Modem waited 30 seconds before hanging up.

12 Normal disconnect initiated by remote modem.
13 Remote did not respond after many transmissions of the same message. Modem tried 10 connection attempts before giving up.
14 Protocol violation occured.

Register S95 - negotiation message options

Register S95 - enables various response codes that indicate the sequence of events in the establishment of an error-control connection (these are listed under "Response Codes"). This register does not affect the way in which the modem negotiates the connection; it merely enables message options. To enable any combination of the bits, add the value(s) to the right of the bit setting does not affect the value set for this register.

Function

4 Enable CARRIER messages
8 Enable PROTOCOL messages
32 Enable COMPRESSION messages

Chapter 6 Dialing A Call

This chapter outlines the procedures for placing a call across dial-up telephone lines. Command syntax and dial modifiers used in specifying the remote system and the dialing methods are explained.

Placing a Call

Connection with remote locations are made with the D (dial) command. A variety of modifiers can be used with this command to specify the method and number to dial.

Dial Command - D

The basic command for connecting with another modem is D followed by the telephone number for the remote system. This command places the modem in originate mode; it then functions as an auto-dialer. For example, ATD7654321 <CR> dials 7654321. Whether the command is issued on a line by itself, or followed immediately by the telephone number, it must be preceded by the AT prefix and terminated with a <CR>.

Note: Parentheses and hyphens in a dial string are ignored by the auto-dialer, but are counted as characters in the 40 character command buffer.

Dial Modifiers

A sequence of dialing modifiers may be placed on the command line with the D command. Modifiers tell the modem what, when, and how to dial.

Dial modifier	Description
0-9, #, *,A,B,C,D	Dial digits/characters for phone number.
T	Tone dial
P	Pulse dial (factory setting)
,	Delay processing of next character
W	Wait for dial tone
@	Wait for silence (no dial tone transmitted)
!	Hookflash
R	Reverse mode (to call an originate-only modem)
;	Return to command state after dialing
S=n	Dial a telephone number stored with the &Zn command (n = 0, 1, 2)

Dial modifiers can be combined and used with the dial command to perform a series of operations within a single command line. The following example illustrates use of several modifiers:

ATDT9,7654321 !, #01234, <CR>

This command line instructs the modem to use tone dialing to access a number outside a PBX, pause before dialing, dial the number 7654321, enter a hookflash, pause, and issue the PBX transfer code #0 before dialing extension number 1234, then return to command state before initiating the handshake.

To initiate a call, the D command or a dial moifier must be the last character on the command line prior to the <CR>.

Digits/characters for dialing - (0-9 # * A B C D)

The digits/characters 0-9 # * are used to specify what numbers the modem will dial. The characters # * represent specific tone pairs and therefore can be used only when tone dialing is selected. These symbols are ignored if included in a telephone number dialed with the pulse method.

Pulse and tone dialing - P, T

The modem can dial with pulse or tone. The factory-set method is pulse. Once either method is selected, it is used until the other is chosen, or the modem is reset.

The T and P modifiers can be issued in conjunction with the dial command,

or alone, to designate the method used for subsequent dialings.

Wait for dial tone - W

The W dial modifier instructs the modem to wait for a dial tone before proceeding. By default, if a dial tone is not detected within 5 seconds, the modem hangs up and returns the NO DIALTONE response code.

Delay processing of next character - ,

The comma (,) modifier in a dial string causes the modem to pause for 2 seconds (or the value held in Register S8) before processing the next character or symbol in the command line. The comma is frequently inserted after the 9 (digit generally used to gain outside access from a PBX) to allow sufficient time for the dial tone to occur before the modem dials the telephone number. Multiple commas can be used to produce longer pauses.

> **Note:** Because the value in Register S8 is not stored in the memory, the duration of the comma modifier depends on the current value in S8, not the value when it was stored.

Wait for silence - @

The @ dial modifier instructs the modem to listen for five seconds of silence before continuing. If a five-second silence has not been detected within 45 seconds, the modem hangs up and returns the NO ANSWER response code. If it detects a busy signal, the modem hangs up and returns the BUSY response code. If it detects the five seconds of silence, the modem processes the remaining characters in the dial string. This modifier is useful when dialing telephone systems that produce no dial tone.

In the following example, the modem dials 7654321 and waits for a silence. It then dials a security code 54321, waits for a second dial tone, then dials extension 321.

ATDT 7654321 @ 54321 W 321 <CR>

The modem listens for silence only after detecting some sound, such as a ring signal.

Hookflash - !

The ! dial modifier issues a flash (hookflash) signal, which causes the modem to hang up for 1/2 second, then reconnect. This feature can be used to access such PBX features as call transfer.

Return to command state after dialing - ;

The semicolon (;) modifier, used only at the end of a command line (just prior to the <CR>, instructs the modem to return to the command state immediately after dialing, without breaking the connection.

The ; is useful when calling an electronic service, such as that offered by a bank, that permits you to use tones to transmit numbers once a connection has been established. The modem can send tones even if your telephone cannot. The example below illustrates the use of the semicolon modifier in communications with an electronic banking service.

Command: ATDP 7654321;<CR> Dials bank using pulse method.

Response Code: OK — Command executed, but keeps the modem in command state (no handshake).

Command: ATDT 4321;<CR> — Sends an ID code via tones and keeps the modem in command state.

Response Code: OK — Modem in command state; command excuted

In this example, the; differs from the +++ in that the escape sequence places the modem in the command state only when two modems have completed a handshake. The semicolon keeps the modem in command state, no CONNECT XXXX response code is displayed, because the handshake is not completed. When a command line is issued without the semicolon, the handshake completes.

Originating a call in answer mode - R

The dial modifier R (Reverse mode) enables the modem to dial an originate-only modem by placing a call in an answer mode. This modifier must be entered at the end of the dialing (D) command string, just before the <CR>.

Storing a Telephone Number - &Zn=

The &Zn= command is used to store four dialing strings in the modem's nonvolatile memory for later dialing. The format for the command is &Zn= "stored number", where n equals 0, 1 or 2.

For example, the line AT&Z2=7654321 <CR> writes 7654321 to the modem's nonvolatile memory 2. The &Zn= command can be used to store three numbers with as many as 33 characters for each number.

Any dialing string can be saved except the S dialing modifier (this would cause a stored dialing string to attempt to dial another stored string), or the; modifier if used to connect in synchronous mode 2.

Dialing a Stored Telephone Number - DS=n

A stored number can be dialed from either an asynchronous or synchronous terminal by following the dial (D) command with the S=n modifier.

ATDS=n <CR> were issued, for example, the modem would dial the stored string in memory n.

Chapter 7 Answering Incoming Calls

This chapter describes how to answer incoming calls. You can have your modem answer the calls automatically or manually.

Answering Calls Automatically

The modem can answer an incoming call automatically according to the number of rings you set. To have the modem answer incoming calls automatically:

1) Set Register S0 to a value greater than zero.
2) Make sure that the DTR interface signal is active.

Setting a value in register S0

Register S0 tells the modem wait for certain number of rings (if any) before it answers. You can set this register to a value between 0 and 255. The default value is 1, which answers on the first ring.

To have the modem answer incoming calls later than the first ring:

1) Type AT S0=n, where n is the number of rings to wait before answers the call. For example, to have the modem answer calls after the forth ring, type AT S0=4.
2) Press the ENTER key. The modem responds with OK (or 0). *For the external modem, the AA LED goes ON to show that automatic answering is enabled.

The modem will answer calls automatically for as many rings as Register S0 is set. Turning the modem's power off and then on, or resetting the modem, returns Register S0 to the value stored in nonvolatile memory.

Note: To verify that automatic answering is working properly, call your modem from another telephone. When the modem answers the call, you should hear a high-pitched answer tone and the LED should react as described in the following Automatic Answering Procedure.

The automatic answering procedure

With automatic answering enabled, the following occur when the modem receives an incoming call from a remote one:

1) Your telephone rings (if connected to the modem).
2) On the modem the AA LED goes off with each ring and sends the RING (or 2) response to DTE.
3) The modem counts the rings, and answers the call on the ring specified in Register S0.
4) The OH LED goes on when the modem goes off-hook and activates its answer tone.

If the modem receives the carrier signal from the originating modem, then it will:

1) Automatically adapt to the baud rate of the remote system.
2) Complete the connection with the remote modem.
*3) For the external modem, the CD LED goes on to show that the carrier signal is received, and the RD goes on when data is received from the remote system.
4) Sends one of the following responses to DTE if you're using a response set other than X0:

CONNECT 14400/REL COMPRESSED for a 14400 bps reliable (MNP) connection with data compression.

CONNECT 9600/REL COMPRESSED for a 9600 bps reliable (MNP) connection with data compression.

CONNECT 4800/REL COMPRESSED for a 4800 bps reliable (MNP) connection with data compression.

CONNECT 2400/REL COMPRESSED for a 2400 bps reliable (MNP)

*** For the External Modem only**

connection with data compression.

CONNECT 1200/REL COMPRESSED for a 1200 bps reliable (MNP) connection with data compression.

CONNECT 300/REL COMPRESSED for a 300 bps reliable (MNP) connection with data compression.

CONNECT 14400/REL for a 14400 bps reliable (MNP) call.

CONNECT 9600/REL for a 9600 bps reliable (MNP) call.

CONNECT 4800/REL for a 4800 bps reliable (MNP) call.

CONNECT 2400/REL for a 2400 bps reliable (MNP) call.

CONNECT 1200/REL for a 1200 bps reliable (MNP) call.

CONNECT 300/REL for a 300 bps reliable (MNP) call.

CONNECT 14400 for a 14400 bps call.

CONNECT 9600 for a 9600 bps call.

CONNECT 4800 for a 4800 bps call.

CONNECT 2400 for a 2400 bps call.

CONNECT 1200 for a 1200 bps call.

CONNECT for a 0-300 bps call.

If the modem does not receive a carrier signal from the originating modem within the time specified in Register S7, then, it will :

Hang up, and return to the Command Mode.

Disabling automatic answering

To disable automatic answering:

Type AT S0=0 <CR> to set the value of Register S0 to zero. The modem responds with OK (or 0).

Answering Calls Manually

To answering calls manually, you can use the A command.

When you receive an incoming call, just type AT A <CR>.

If the modem receives the carrier signal from the originating modem, it will:

1) Automatically adapt to the baud rate of the remote system.
2) Complete the connection with the remote modem.
*3) For the external modem, the CD LED goes on to show that the carrier signal is received, the RD goes on when data is received from the remote system, and the respective 96/24/12 LED goes on if the connection is made at respective speeds.
4) Sends a response to DTE if you're using a response set other than X0, the response is as described in the Automatic Answering Procedure.

If the modem does not receive a carrier signal from the originating modem within the time specified in Register S7, then it will:

Hang up, and return to the Command Mode.

Answering a Voice Call Manually

The modem is so versatile, it lets you talk with the person at the remote location before it answers the call. This feature is especially useful when you want to talk something about the data connection, such as the name and number of files to be exchanged.

Note: To answer a voice call manually, your telephone must be connected to the "TO PHONE" jack on the back of the modem.

To answer a voice call manually, follow the procedure below:

1) When there is an incoming call, pick up your telephone handset and talk (as you would with any voice call).
2) When you both are ready to let the modems exchange data:
   The answering person types AT A < CR >.
   The calling person types ATX1 D < CR >.
3) Hang up both telephones.

Executing commands before manually answering a call

*** For the External Modem only**

You can have the modem execute commands before answering an incoming call by typing the commands prior to the A command. For example, typing : AT X4 E0 A <CR>

Tells the modem to:

1) Use the X4 response set.
2) Stop echoing command character (E0).
3) Answer the incoming call (A).

Note: The modem will not execute any commands that follow the A command on the same command line.

Answer Timing Registers

Table 7-1 describes the modem registers that affect the answer features described in this chapter. For a complete description, including the way to change register values, refer to Chapter 5.

Table 7-1 Registers that affect answering

Register	function	Factory set value
S0	number of rings before the modem answer an incoming call automatically (a zero value turns off auto-answer).	1 ring
S7	The time in seconds the modem waits for the carrier signal after answering.	45 seconds
S9	Number of hundred milliseconds the carrier signal must last for the modem to recognize it.	6 hundred milliseconds
S10	Number of hundred milliseconds from lost of carrier to local modem hans up.	14 hundred milliseconds

Chapter 8 Non-volatile Memory

The modem features an advanced nonvolatile memory that eliminates some switches and jumpers found on other modems. Nonvolatile memory also eliminates the need of batteries, it preserves your operating characteristics even when the modem is turned off.

Random-access Memory

The Random-Access Memory (RAM) in the modem contains the current operating characteristics, obtained from the S register values. The S registers determine modem operating characteristics such as Bell or CCITT operation, originate or answer operation.

Read-only Memory

When you turn on or reset the modem, the S registers obtain some values from the firmware Read-Only Memory (ROM) and others from the nonvolatile memory. The ROM stores the factory-set parameters.

Non-volatile Memory

The non-volatile memory lets you store the most frequent operating characteristics. The parameters remain in non-volatile memory even when the modem is turned off. Each time the modem is turned on or reset, it retrieves its operating characteristics from nonvolatlie memory.

Table 8-1 lists the operating characteristics in non-volatile memory.

Table 8-1 Operating characteristics you can store in non-volatile memory

Asynchronous Parity Bit(S23)	Even, Odd, Space, Mark, None
Automatic Answer	Enabled or Disabled
Automatic Answer on Ring n(S0)	n = 0-255 rings
Baud Rate	14400, 9600, 4800, 2400, 1200, or 300.
Communication Compatibility	Bell or CCITT
Data Carrier Detect (S21) Interchange Circuit	Forced Active or Switched
Data Terminal Ready (S21) Interchange Circuit	Forced Active, Switched-Disconnect, Switched Reset, Dial Stored Number, Talk/Data Switching.
*Delay before Examining (S25) Data Terminal Ready	(Synchronous Operation Only) (For the external modem only)
Dialing Method (S14)	Pulse or Touch-Tone
DTE Commands Echoed by Modem (S14)	Enabled or Disabled
Duration of Test Timer (S18)	1-255 seconds
Type of Responses (S14)	Words or Digits
Guard Tones (S23)	Enabled or Disabled
Long Space Disconnect (S21)	Enabled or Disabled
Make/Break Ratio (Pulse dialing) (S22)	39/61 (for USA) or 33/67 (for UK and Hong Kong)

*** For the External Modem only**

Request for Remote (S16) Digital Loopback	Grant or Deny
Retrain	Enabled or Disabled
Responses Code (S14)	Enabled or Disabled
Response Set (S22)	X0, X1, X2, X3, or X4
Speaker Volume (S22)	Low, Medium, or High

Note : All of the MNP command sets, V.42 and V.42 bis S Registers can be stored in non-volatile memory.

Storing New Configuration Characteristics

The modem comes from factory is ready to use for most applications. Table 8-2 shows the default operating characteristics of it.

These operating characteristics will fit most of the applications, you'll be able to use the modem with its default configuration. However, if you have to change the factory settings, you can do it by sending a command line that contains:

1) Commands that override the ones in the nonvolatile memory (refer to Chapter 4).
2) New register values that override the ones in the nonvolatile memory (refer to Chapter 5).
3) &W command, and &W1 command.

When you type a command line that contains the commands or register values, the &W command writes your new commands or register values to the nonvolatile memory.

Without the &W command, the operating characteristics you change remain effective only before you turn off your personal computer, or reset the modem; because the changes are not stored in the nonvolatile memory, with

&W command the modem will have the changed operating characteristics stored in nonvolatile memory, so that they can be recalled after power on again.

Table 8-2 Default operating characteristics

Automatic Answer Enabled

CCITT V.32 bis/V.32/V.22 bis/V.22/V.21 compatible (B0)

Data Carrier Detect is Active when Remote Carrier Signal is Detected (&C1)

No Parity

Guard Tones Disabled (&G0)

Long Space Disconnect Disabled (Y0)

Originate Mode

Modem Echoes Commands (E1)

Modem Sends Word Responses (V1)

Make/Break Ratio for Pulse Dialing is 39/61 (&P1)

Modem Honors Remote Requests for Remote Digital Loopback (&T4)

Modem Hangs Up, Enters Asynchronous Command Mode, and Turns Off (&D2)

Auto Answer Following Data Terminal Ready on-to-off Transition

Retraining Enabled

RJ11, RJ41S, RJ45S Jack (&J0)

Speaker Turned On Except when Receiving Carrier (M1)

Speaker Volume Set to Medium (L2)

Test Timer Set to Zero Seconds (&T0)

Characteristics You Cannot Store in Non-volatile Memory

Table 8-3 lists the operating characteristics you cannot store in non-volatile memory. You can change these characteristics in RAM;however, when you turn your modem off and on, or reset it, the modem reverts to the operating characteristics set up in nonvolatile memory.

Table 8-3 Characteristics you cannot store in non-volatile memory

Count Number of Rings (S1)	00 rigns
Escape Character (S2)	43 ASCII
Carriage Return Character (S3)	13 ASCII
Line Feed Character (S4)	10 ASCII
Backspace Character (S5)	8 ASCII
Wait time for Blind Dialing (S6)	2 seconds
Wait Time for Carrier/and Dial Tone(S7)	30 seconds
Duration of Dial Pause (S8)	2 seconds
Carrier Detect Response Time (S9)	0.6 seconds
Time Between Loss of Remote Carrier and Modem Disconnect (S10)	1.4 seconds
Escape Character Guard Time (S12)	1 second

Returning to the Factory Settings

The factory settings shown in Table 8-3 are stored permanently in the modem's ROM. You can restore the modem to the default operating characteristics by the &F command. This command causes the modem to establish its operating characteristics according to the default operating characteristics retrieved from ROM.

You can optionally write these settings to nonvolatile memory by including the &W command in your command line.

*Chapter 9 Operating Synchronously

This chapter describes how to operate the modem synchronously. If you use only asynchronous operations, you can skip this chapter.

Three Synchronous Modes

The modem provides three synchronous modes:

1) &Q1 - supports terminals that can operate both asynchronously and synchronously using the same RS-232 port. You can also use this synchronous mode by switching your RS-232 cable between an asynchronous terminal and a synchronous terminal.

2) &Q2 - supports dedicated synchronous data terminals. The modem dials a stored telephone number automatically when the DTR signal turns on, then enters the synchronous Data Mode.

3) &Q3 - also supports a dedicated synchronous terminal. The modem responds to the DTR signal as if it were a talk/data switch, allowing you to dial a call manually using the telephone connected to the modem.

For the synchronous operating modes described in this chapter, you should use an synchronous data terminal or a computer that emulates a data terminal to configure the modem.

Synchronous Operation Guidelines

Before operating the modem synchronously, please follow the guidelines.

Configurating the modem for "dumb" mode

The modem is factory-configured to accept asynchronous commands, echo

them, and respond with asynchronous response codes.

If you use the &M2 and &M3 commands, you mean to configure the modem for "dumb" mode. In "dumb" mode, the modem neither accepts asynchronous commands, nor sends asynchronous responses. Thus preventing misinterpreting synchronous signals as the asynchronous AT command sequence.

To configure that modem for "dumb" mode, refer to chapter 1, the Smart/ Dumb Jumper.

Data terminal ready options

The Data Terminal Ready (DTR) interface signal plays an important role in establishing modem connections and hanging up. Your DTE controls the DTR interface signal to the modem; the remote DTE controls the DTR interface signal to the remote modem.

The &D command handles the DTR signal when the modem operates asynchronously. Do not use the &D command for asynchronous applications.

Timing source

In synchronous mode, a timing source is needed to clock the data exchanged between the local and remote system. By default, the modem will supply the timing. Or you can use the &X1 command, to have DTE provide the timing source to the modem (refer to Appendix D for more information).

Request to send/clear to send delay options

The modem is factory-configured with the &R0 command in effect. This command enables the Request To Send (RTS)/Clear To Send (CTS) time-delay effective only during synchronous operation. It is generally used to emulate half-duplex operation.

Register S26 contains the time delay between the RTS signal and the CTS signal. This register accepts a value between 000 and 255 hundredths of a second. It is default value is 001, indicating that the modem waits for a 10 millisecond RTS/CTS time delay. When the RTS signal becomes inactive, the CTS signal derectly follows and becomes inactive.

If you require a delay to simulate half-duplex operation, you can change the value of Register S26 (refer to Chapter 5 for more information).

If you don't want to use this option, use the &R1 command to disable it. The CTS signal remains active continuously, regardless of the status of the RTS signal; however, CTS goes off during the handshaking.

Saving your operating parameters

You can save the modem's parameter in nonvolatile memory. The parameter settings are preserved when the modem is turned off. To save the configuration, use the &W command; the modem then saves (or writes) the current parameter seetings to its nonvolatile memory. Current settings becomes your default configuration after you turn on your modem or reset it.

If you configured the modem for "dumb" operation, you must return it to normal operation to save the parameters.

Synchronous Mode 1: sync/async mode - &Q1

Synchronous mode 1 is intended to support terminals capable of communicating both synchronously and asynchronously over the same RS-232C port. In synchronous mode 1, a call is originated using asynchronous methods from the command state with theD or A command. The modem automatically switches to the synchronous on-line state when the CONNECT XXXX response code is delivered to the terminal.

If the modem receives a character while dialing the telephone number, it aborts the call and sends the OK response code; if a character is received after dialing but prior to the completion of the connection, it aborts the call and sends the NO CARRIER response code.

The data terminal must supply an DTR "ON" signal before on-line data transfer can begin. Once the CONNECT XXXX response code is received, the modem delays a period of time determined by Register S25 before examining the condition of the DTR signal. If DTR is on, the modem enters the synchronous on-line state. If DTR is off, the modem hangs up and returns to the asynchronous command state.

The modem exits the synchronous on-line state and returns to the asynchronous command state when a loss of carrier exceeding the time interval stored in Register S10 is detected. If the &D1 option is enabled, an on-to-off transition of DTR causes the modem to return to the asynchronous command

state without terminating the connection. If the &D2 option is selected, the modem hangs up and returns to the asynchronous command state. If the &D3 option is selected, an on-to-off of DTR causes the modem to reset itself.

The diagram below illustrates how the modem operates in synchronous mode 1.

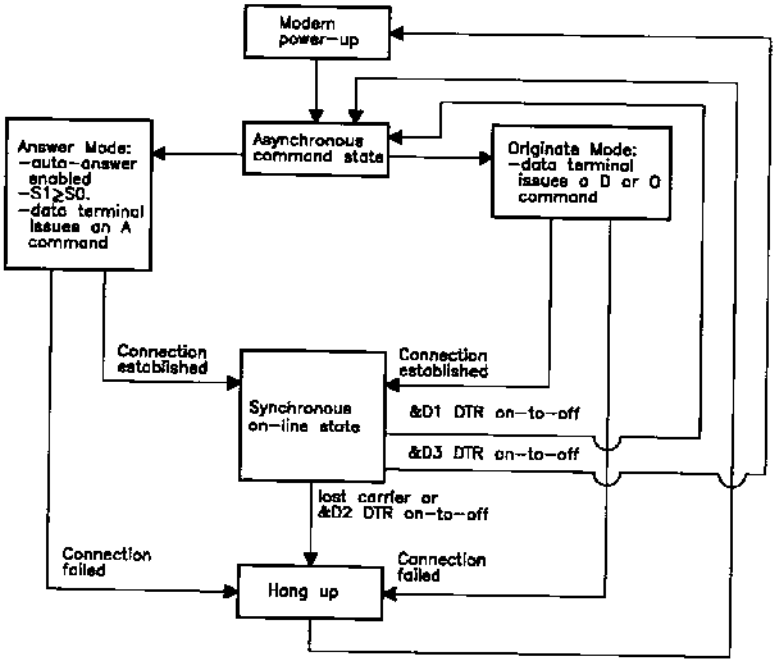


Fig 9-1 &Q1 synchronous mode

Synchronous Mode 2: stroed number dial - &Q2

In this mode, the modem supports a synchronous-only data terminal or computer with a synchronous adapter card. In synchronous mode 2, the modem

automatically dials a number stored in nonvolatile memory when the modem detects an off-to-on transition on DTR (when DTR turned on). Once on-line, the modem hangs up and returns to the asynchronous command state when it detect an on-to-off transition of DTR exceeding the value set in S25.

Synchronous mode 2 is similiar to the CCITT Recommendation V.25bis ("Direct call and/or answer controlled by the DTE").

The diagram below illustrates how the modem operaties in synchronous mode 2:

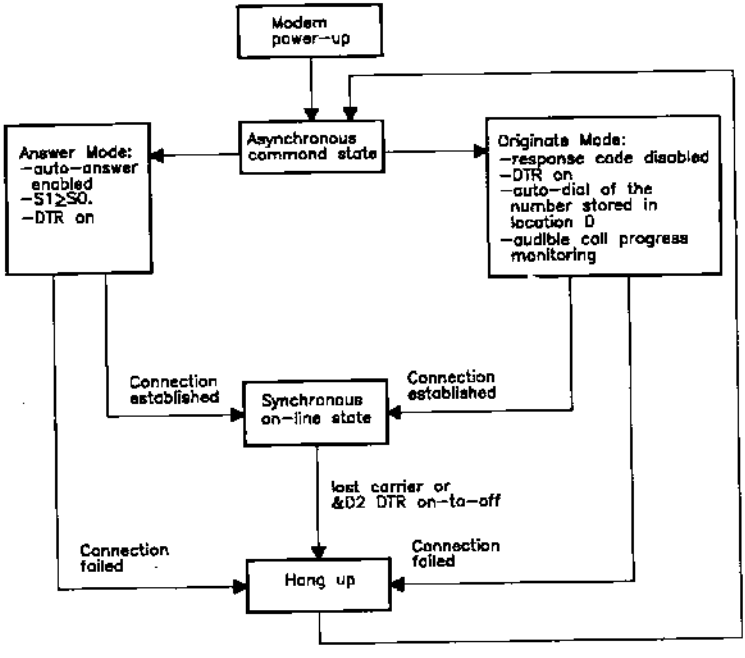


Fig 9-2 &Q2 synchronous mode

The modem exits the synchronous on-line state and returns to the asynchronous command state when a loss of carrier exceeding the time interval stored in Register S10 is detected. An on-to-off transition of DTR causes the modem

to hang up and return to the asynchronous command state. The DTR response specified by the &D command is ignored when the modem is configured for this mode.

> **Note:** Once this mode is selected, the modem may go off-hook and begin dialing the stored number as soon as the modem is connected to the terminal. To prevent this, turn the modem off before connecting the devices. Turn the modem on, after the connection is made.

Synchronous Mode 3: manual dial with data/talk switch - &Q3

In synchronous mode 3, the DTR interchange circuit serves as a data/talk switch. This mode supports a synchronous-only data terminal or computer with a synchronous adapter card. A telephone must be attached to the jack labelled "TO PHONE" on the rear of the modem. This mode permits the data terminal operator to initiate a call using the handset with the modem in "talk mode". After dialing, switch the modem to the "data mode" by turning on the DTR interchange circuit.

To originate a call in synchronous mode 3, the DTR interchange circuit must be off. This places the modem in talk mode. When the modem has been configured for this mode with the &M3 command, the terminal operator can lift the telephone handset and dial the number. After dialing, the modem should be switched to data mode by turning on the DTR signal. The operator should then hang up the telephone. When the data terminal equipment turns on DTR, the TR indicator lights up on the modem's front panel.

The modem exits the synchronous on-line state and returns to the asynchronous command state when a loss of carrier exceeding the time interval stored in Register S10 is detected. An on-to-off transition of DTR causes the modem to hang up and return to the asynchronous command state. The DTR response specified by the &D command is ignored when the modem is configured for this mode.

The diagram below illustrates how the modem operates in synchronous mode 3:

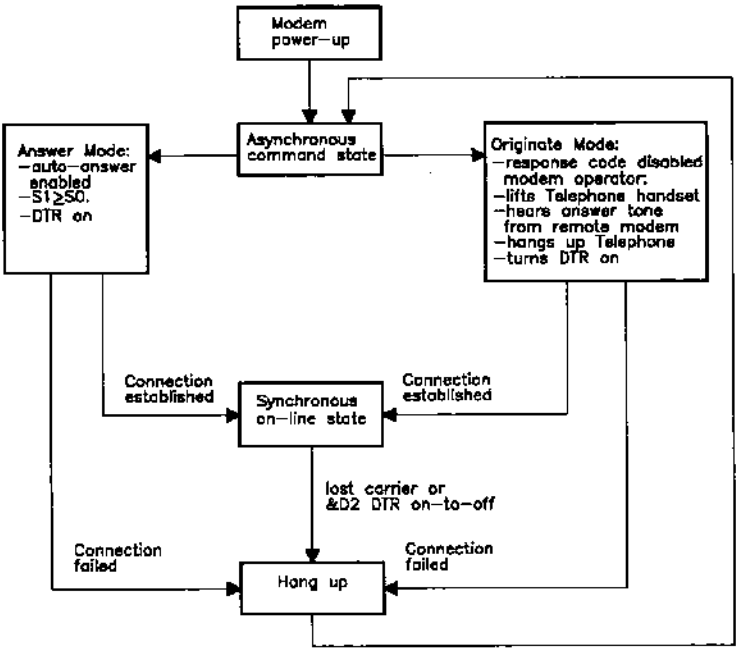


Fig 9-3 &Q3 synchronous mode

If the connection fails, the modem automatically hangs up and switches from data to talk mode. To reinitiate the call, DTR must again be turned off.

*** This Chapter is for the External Modem only**

Chapter 10 Diagnostics

The test features outlined in this chapter help you locate the source of a communication problem, see whether it is caused by the local modem, the remote modem, or connections in between. Although these tests are oriented toward problems in a new installation, they are also useful if a previously working modem suddenly failed.

Throubleshooting Tips

A communication link problem may be simply due to a bad switchboard connection. Before calling the telephone company, however, you should make sure that the problem is not caused by faulty or improperly connected equipment at your end.

In some cases, apparent modem failures may be caused just by a power surge, improper changed parameters in your software, an incompatible component in the communication link, an improper connection, or simply a device is not plugged in or turned on. Before you initiate the tests described in this chapter, re-examine your telecommunications equipments to make sure none of the above conditons could be a cause of the failure.

Follow these steps first to eliminate common faults. (If using communications software, consult your software manual for troubleshooting information.)

Step 1: If your commands seems not reaching the modem, make sure it has been installed properly. Also check to make sure the telephone line is plugged into the jack maked "TO LINE" and not into the jack marked "TO PHONE"

Step 2: Issue AT&F <CR> to restore the modem's factory configuration to make sure the modem's settings are not preventing you from making a connection.

Step 3: If you receive an OK response code, issue ATDTXXXXXX<CR> If you are calling out of a PBX, remember to include the 9 or other outside access code in the phone number. Listen for a dial tone, followed by the tone dialing beeps. When these occur, they ensure you've entered the phone number correctly, and the local phone line is responding properly.

If there is no dial tone, check the phone line by dialing with an ordinary telephone. Note that some PBX system must be modified to produrce at least 48 volts DC for the modem to work.

Step 4: If you hear the phone on the other end ringing, then the remote phone line is responding properly. Hang up by ATH <CR>.

Step 5: Try dialing another modem to see if you can make a connection. A connection is indicated by two whistling sounds of different tones (the sound of carriers), followed by a hissing sound. The modem should respond with a CONNECT response code.

When you have reached this point successfully, both modems have done their job.

If no errors occurred with these steps, the problem is related to software, user error, or improper modem installation/setup. If this procedure indicate a problem with the modems or the communication link, go on to the modem testing instructions in the next section.

Available Tests

Failures in a point-to-point communication link, usually characterized by unacceptably high error rates or total inability to communicate, may be the fault of either the local or remote data terminal equipment, the local or remote modem, or the telephone company circuit. The modem's diagnostic and test facilities enable you to determine the source of the problem:

1) Local Analog Loopback: Tests the path that includes the local modem and local data terminal equipment.
2) Remote Digital Loopback: Verifies the path that includes the local data terminal equipment, local modem, remote modem, and telephone circuit.
3) Local Digital Loopback: Tests the communication link, the local modem, and the remote modem(permits a non-CCITT compatible remote modem

to engage in a digital loopback test with the local modem).

4) Internal Memory and Product Code: Checks the modem's ROM and displays the product/firmware revision numbers.

Do not call the telephone company until you have performed these tests and ruled out operator errors and failures of your equipment or the remote equipment. In addition, the test results may be of help when explaining the problem.

Performing a Test

Tests are performed by issuing AT commands to the modem. Some tests require a connection be established. Others, like the internal memory diagnostics, check the local modem only and therefore do not require a link with a remote modem. The procedures below explain how to initiate and terminate tests.

Initiating a test

All of the diagnostic tests are initiated from the asynchronous command state.

To use the loopback tests:

1) Establish a connection (when directed).
2) Return to the command state by issuing the escape sequence (+++), or if the &D1 option is selected, by generating an on-to-off transition of DTR
3) Issue the appropriate &T command.

Terminating a test in progress - &T0

A test may be terminated in the command state at any time by issuing the &T0 command. If the local analog loopback or remote digital loopback tests are performed, it is necessary to issue the escape sequence to return to the command state prior to sending &T0. Commands that follow &T0 in a command line are ignored.

Entering the H command will also terminate a test, leaving the value of Register S18 at its current value; A soft reset with the Z command terminates the test, resetting the value in Register S18 to 0, reconfigures the modem with the selected profile. Both of these techniques break the connection.

Setting the test timer - S18=

The S18 test timer determines the duration of the diagnostic test. When a test has been active for a period equal to the value set to this register (from 1 to 255 seconds), the modem will automatically stop the test and return to the command state. For example, if the register value is set to 10 with ATS18 = 10 <CR>, when a test is initated, it will continue for 10 seconds. Loading S18 with zero disables the test timer (factory setting).

Testing with Analog Loopback

Use the analog loopback tests if you suspect the modem is causing errors in data transmission.

The local analog loopback test will verify both the local modem and the local data terminal equipment. If this test fails the data terminal equipment or than the modem may be at fault.

Local analog loopback - &T1

This test is used to verify the integrity of the path between the local modem and the local data terminal equipment.

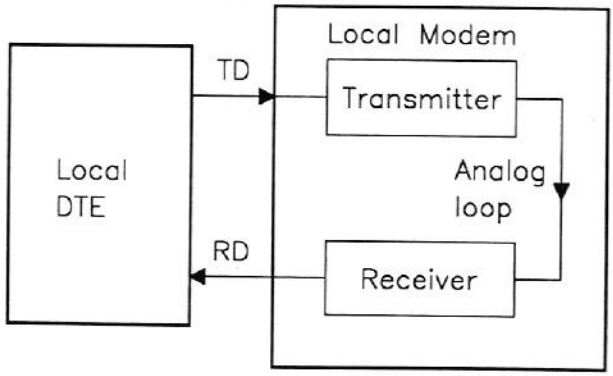


Fig 10-1 Local Analog Loopback Test

Set the local data terminal equipment to echo characters and the local modem to echo commands received from the local data terminal (the E1 option selected). Initiate the test with &T1. Type a few sentences they will be looped back to the local data terminal.

If the modem echoes your keyboard input to the screen as you typed it, the modem is operating correctly. If not, the modem may be faulty. To end the test, enter the command state and issue the &T0 command.

Testing with Digital Loopback

Local digital loopback and remote digital loopback together test all of the components in the communication link, including the modems. Data sent from one modem is looped back to it by the other modem without going through the other modem's computer. Local digital loopback tests the communication link from the remote modem; remote digital loopback tests the communication link from the local modem.

When either local or remote digital loopback indicates a modem problem rather than a communication link problem, both parties should run local analog loopback to test the modems. If both modems test good but the problem still exists, disconnect and place another call. If the problem persists, the phone line or the component in the communication link is faulty.

Remote digital loopback - &T6

Remote Digital Loopback verifies the operation of both modems, the local data terminal equipment, and the telephone circuit by commanding the remote modem to loop data back to the local modem.

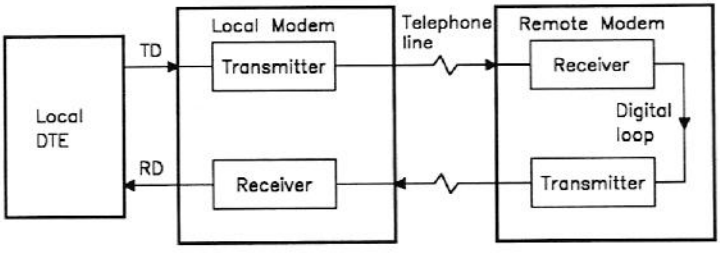


Fig 10-2 Remote Digital Loopback Test

Before initiating remote digital loopback, establish a connection with a remote modem. Then, enter the command state and issue the &T6 command to begin the test.

Type a few sentences, they will be looped back to the local terminal without appearing on the remote screen. If the modem echoes your keyboard input to the screen as you typed it, the local modem is operating correctly. If the received data does not match what you typed, one of the modems or the local communication link is not functioning properly. To end the test, enter the command state and issue the &T0 command.

Note: The local modem requests a digital loopback with the remote modem through a special CCITT standard handshake sequence. The remote modem automatically acknowledges the request if it has been conditioned to do so with the &T4 command. (See the discussions on the &T4 and &T5 commands.)

Local digital loopback - &T3

Local digital loopback tests the communication link and the remote modem. During this test, the local modem loops incoming data directly back to the remote modem.

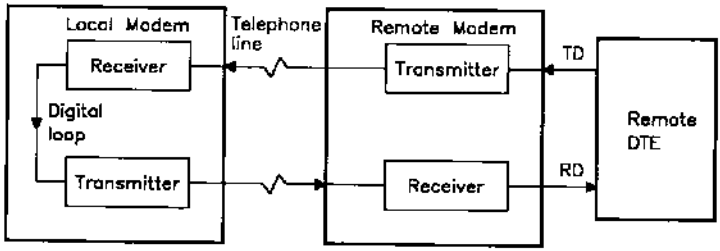


Fig 10-3 Local Digital Loopback Test

To initiate local digital loopback,establish a connection with a remote modem, then enter the command state and issue the &T3 command.

The operator at the remote system should type in a few sentences. They will be looped back to the remote data terminal. When the operator at the remote system indicates that the test is complete, enter the command state and issue the &T0 command to end the test. If the operator at the remote system reports that the data came back without errors, the remote modem and the communication link are functioning properly.

Grant RDL request from remote system - &T4

This command configures the local modem to grant a request from the remote modem for their remote digital loopback test (factory setting).

Deny RDL request from remote system - &T5

This command prohibits the local modem from granting a request from the remote modem for their remote digital loopback test.

Testing Internal Memory

The various forms of the I command permit the modem to query its memory for information about itself. These tests request information about the modem's firmware; therefore, it is not necessary to connect with a remote system before issuing the I command.

Displaying product code - I0

If the I0 command is issued, the modem will respond with its product code in the form of a three-digit ASCII string (e.g., 24x-where "x" is the modem revision level) followed by a carriage return and line feed. Generally, this test is performed to determine the revision level of a product.

Testing ROM checksum - I1

The I1 command tests the modem's ROM checksum. The result of this command should be a three-digit number, the sum of all bytes in ROM.

Testing ROM memory - I2

This test calculates the bytes in ROM and compares the total against the correct sum, stored in ROM. Rather than returning a value in the way the I1 command does, the I2 command generates a response code. If the two figures agree, internal memory is complete and OK is displayed. If the totals are different, the ERROR response code is returned.

Testing ROM checksum - I3

The I3 command tests the modem's ROM and checksum of error correction and data compression. The result of this command should be a three-digit number, the sum of all bytes in ROM of error correction and data compression.

Appendix A

Specifications

This appendix summarizes the modem's physical and operation specifications.

*Enclosure	137mmx237mmx37mm
*Front panel LED indicators	TST - Error Correcting AA - Auto Answer CD - Carrier Detect OH - Off-Hook RD - Receive Data SD - Send Data TR - Terminal Ready (DTR) MR - Modem Ready 96/24/12 - Speed Indicator (Refer to page 1-3)
*Rear panel	Two modular telephone jacks, one RS-232C female connector (DB-25S), one AC power adaptor jack and on-off switch.
*Power supply	UL-listed 120VAC 60H/50Hz 220/230/240 VAC input, 12 VAC output. Rectified, filtered, and regulated circuit inside the modem.
Power consumption	5 watts
Interface	*EIA RS-232C serial interface (for external modem) #IBM PC XT/AT/286/386 AT BUS (for internal modem)
Audio monitor	2-inch speaker with programmable volume control
Command buffer	40 characters
Registration	FCC Part 68 and Part 15 (sub-part B, section B) approved.

*** For the External Modem only**
 # For the Internal Modem only

Compatiblility	CCITT V.32 bis 14400 bps, 12000 bps, 9600 bps and 4800 bps asynchronous/*synchronous. CCITT V.32 9600 bps and 4800 bps asynchronous /*synchronous. CCITT V.22 bis 2400 bps and 1200 bps asynchronous /*synchronous. CCITT V.22 1200 bps asynchronous/*synchronous. CCITT V.21 0-300 bps asynchronous. CCITT V.23 1200/75 bps asynchronous Bell 212A 1200 bps asynchronous/*synchronous. BELL 103 0-300 bps asynchronous. (*Synchronous mode is for external modem only)
Modulation	14400 bps (CCITT V.32 bis) - Trellis Codes Modulations (TCM) 9600 bps (CCITT V.32 bis) - Trellis Codes Modulations (TCM) 4800 bps (CCITT V.32 bis) - Quadrature Amplitude Modulation (QAM) 9600 bps (CCITT V.32) - Trellis Codes Modulations (TCM) 9600 bps (CCITT V.32) - Quadrature Amplitude Modulation (QAM) 4800 bps (CCITT V.32) - Quadrature Amplitude Modulation (QAM) 2400 bps (CCITT V.22 bis) - Quadrature Amplitude Modulations (QAM). 1200 bps (CCITT V.22 and Bell 212A) - Differential Phase Shift Keying (DPSK). 1200/75 bps (CCITT V.23) - Frequency Shift Keying (FSK). 300 bps(Bell 103 and CCITT V.21) - Frequency Shift Keying (FSK).
Operation	Full duplex or half duplex, two-wire leased line or dial-up line operation.
Communication modes	Asynchronous data transmission modes. * Three synchronous data transmission modes for

*** For the External Modme only**

	external modem only.
Asynchronous data format	High speed data format (57600/38400/19200/ 14400/9600/4800/2400/1200 bps) Serial, binary, asynchronous: 7 data bits; 1 or 2 stop bits; odd, even or fixed parity. 8 data bits; 1 or 2 stop bits; no parity Low speed data format (0-300 bps) Serial, binary, asynchronous: 7 or 8 data bits; 1 or 2 stop bits; odd, even, or no patity.
*Synchronous modes	Synchronous Mode 1 - Sync/Async Mode Synchronous Mode 2 -Stored Number Dial Mode Synchronous Mode 3-Manual Dial Mode
DTE data rate	57600, 38400, 19200, 14400, 9600, 4800, 2400, 1200 or 300bps.
Equalization	Transmitter: fixed compromise equalization Receiver : adaptive equalization
Receive signal frequency tolerance	± 10 Hz
Receive sensitivity	- 43 dBm
Transmit level	-11 ± 1 dBm
Echo suppressor	Bell mode: 2225 Hz ± 10 Hz
Defeat tones	CCITT modes: 2100 Hz ± 15 Hz
Guard tone	550 or 1800 Hz selectable by software commands

Transmitter Signal Frequencies:

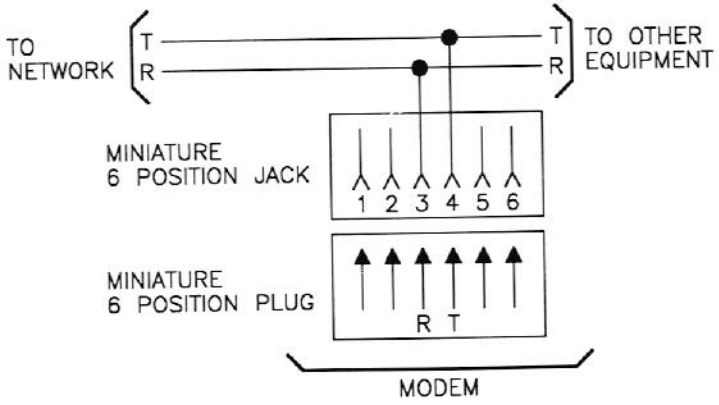
V.32 bis channel, originate and anwser mode	1800 ± 0.01%
V.32 channel, originate and anwser mode	1800 ± 0.01%
V.22 bis low channel, originate mode	1200 ± 0.01%
V.22 bis high channel, answer mode	2400 ± 0.01%
V.22 low channel, originate mode	1200 ± 0.01%
V.22 high channel, answer mode	2400 ± 0.01%
V.23 originate mark	390 ± 0.01%
V.23 originate space	450 ± 0.01%
V.23 answer mark	1300 ± 0.01%
V.23 answer space	2100 ± 0.01%
V.21 originate mark	980 ± 0.01%
V.21 originate space	1180 ± 0.01%
V.21 answer mark	1650 ± 0.01%
V.21 answer space	1850 ± 0.01%
Bell 212A low channel, originate mode	1200 ± 0.01%
Bell 212A high channel, answer mode	2400 ± 0.01%
Bell 103, originate mark	1270 ± 0.01%
Bell 103, originate space	1070 ± 0.01%
Bell 103, answer mark	2225 ± 0.01%
Bell 103, answer space	2025 ± 0.01%

Diagnostic facilites	Local analog loopback test Remote digital loopback test Local digital loopback test Programmable test-timer
Dialing capability	Touch-tone dialing and pulse dialing (rotary dialing)

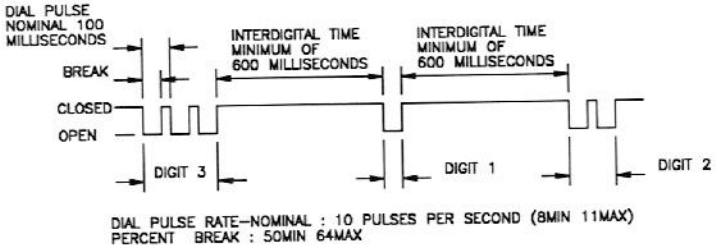
Appendix *B*

Modular Telephone Diagrams

This appendix summaries the modular telephone diagrams, dial pulse and touch-tone specifications.



RJ11 Modular telephone diagram



Dial pulse specifications

	North America	Japan	Other area
Break Ratio	61%	67%	67%
Break Length	61ms	67ms	67ms
Dial Pulse Length	100ms	200ms	100ms
Dual Pulse Rate	10pps	20pps	10pps
Interdigit Time	789ms	783ms	783ms

Touch-tone Frequencies

	1209	1336	1477	1633Hz
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941Hz	*	0	#	D

*** For the External Modem only**

Appendix C

ASCII Character Table

The conversion table below lists the complete set of ASCII characters coded for digital processing in binary notation (base 2). They are listed below with their equivalents in decimal notation (base 10) and hexadecimal notation (base 16).

CODE	DEC	HEX	CODE	DEC	HEX	CODE	DEC	HEX	CODE	DEC	HEX
NUL	0	00	SP	32	20	@	64	40	,	96	60
CTRL A	1	01	!	33	21	A	65	41	a	97	61
CTRL B	2	02	"	34	22	B	66	42	b	98	62
CTRL C	3	03	#	35	23	C	67	43	c	99	63
CTRL D	4	04	$	36	24	D	68	44	d	100	64
CTRL E	5	05	%	37	25	E	69	45	e	101	65
CTRL F	6	06	&	38	26	F	70	46	f	102	66
CTRL G	7	07	,	39	27	G	71	47	g	103	67
CTRL H	8	08	(	40	28	H	72	48	h	104	68
CTRL I	9	09	)	41	29	I	73	49	i	105	69
CTRL J	10	0A	*	42	2A	J	74	4A	j	106	6A
CTRL K	11	0B	+	43	2B	K	75	4B	k	107	6B
CTRL L	12	0C	,	44	2C	L	76	4C	l	108	6C
CTRL M	13	0D	-	45	2D	M	77	4D	m	109	6D
CTRL N	14	0E	.	46	2E	N	78	4E	n	110	6E
CTRL O	15	0F	/	47	2F	O	79	4F	o	111	6F
CTRL P	16	10	0	48	30	P	80	50	p	112	70
CTRL Q	17	11	1	49	31	Q	81	51	q	113	71
CTRL R	18	12	2	50	32	R	82	52	r	114	72
CTRL S	19	13	3	51	33	S	83	53	s	115	73
CTRL T	20	14	4	52	34	T	84	54	t	116	74
CTRL U	21	15	5	53	35	U	85	55	u	117	75
CTRL V	22	16	6	54	36	V	86	56	v	118	76
CTRL W	23	17	7	55	37	W	87	57	w	119	77
CTRL X	24	18	8	56	38	X	88	58	x	120	78
CTRL Y	25	19	9	57	39	Y	89	59	y	121	79
CTRL Z	26	1A	:	58	3A	Z	90	5A	z	122	7A
ESC	27	1B	;	59	3B	[	91	5B	{	123	7B
FS	28	1C	<	60	3C	/	92	5C	|	124	7C
GS	29	1D	=	61	3D	]	93	5D	}	125	7D
RS	30	1E	>	62	3E	^	94	5E	~	126	7E
US	31	1F	?	63	3F	-	95	5F	DEL	127	7F

*Appendix D

RS-232C Connections

This appendix provides EIA RS-232C connector pin assignments and circuit descriptions of each signal.

Answer on RS-232C pin assignments

Pin number	Circuit	Direction	Description
1	AA	N/A	Protective Ground
2	BA	To Modem	Transmit Data
3	BB	From Modem	Receive Data
4	CA	To Modem	Request To Send
5	CB	From Modem	Clear To Send
6	CC	From Modem	Data Set Ready
7	AB	N/A	Signal Ground
8	CF	From Modem	Data Carrier Defect
12	CI	From Modem	Select Alternate Rate#
15	DB	From Modem	Transmit Clock##
17	DD	From Modem	Receive Clock##
20	CD	To Modem	Data Terminal Ready
22	CE	From Modem	Ring Indicator
23	CI	From Modem	Select Alternate Rate#
24	DA	To Modem (DTE Source)##	Transmit Clock

\# CI is output on both pin 12 (Bell 212A assignment) and pin 23 (EIA RS232C assigment

\## These signals are used for synchronous communication.

RS-232C circuit descriptions

Protective Ground (pin 1)

Grounds modem according to local regulations. The ground pin is electrically bonded to modem case.

TD - Transmit Data (pin 2)

Modem receives serial data from the local data terminal equipment on this pin.

RD - Receive Data (pin 3)

Modem transmits data to the local data terminal equipment on this pin.

RTS - Request To Send (pin 4)

Puts modem into transmit mode of operation rather than receive mode. When operating asynchronously, the modem ignores this circuit. In synchronous, on-line operation, modem can be programmed to ignore RTS or respond to RTS by turning on CTS after the delay specified by Register S26. This is controlled with the &R command. When in command state, modem always ignores RTS.

CTS - Clear To Send (pin 5)

Indicates whether modem is ready to accept data, from a terminal or a computer, for transmission. When operating asynchronously, the modem maintains CTS signals on. In synchronous command state, the modem maintains CTS signal on. The modem turns CTS off immediately upon going off-hook, and maintains CTS off until both DSR and DCD are on and the modem is fully prepared to transmit and receive synchronous data. The modem can also be programmed to turn CTS on in response to an off-to-on transition of RTS (see discussion of &R command).

DSR - Data Set Ready (pin 6)

Indicates whether modem is connected to a communication channel and is ready to exchange control characters to initiate data transmission. When operating asynchronously, the modem can be programmed to maintain DSR on at all times or to cause DSR to operate in accordance with EIA RS-232C specification. In synchronous mode. DSR always operates according to RS-232C specification. (See discussion of &S command).

Signal Ground (pin 7)

Common reference for all signals on connector.

DCD - Data Carrier Dectect (pin 8)

Indicates whether the receiver section of the modem is or is not accepting transmitted data. When operating asynchronously, the modem can be programmed to maintain DCD on at all times, or to track the presence of a data carrier from the remote modem. In synchronous mode, this signal tracks the presence of a data carrier from a remote modem. (See the discussion of the &C command).

Alternate Rate Select (pins 12 and 23)

The modem turns on this signal to indicate selection of the highest rate for the active communication standard (for Bell, 1200 bps; for CCITT, 2400 bps).

TxC - Transmit Clock (pin 15)

provides the transmitting section of the modem with timing information. Synchronizes the local modem transmitter and the remote modem receiver. Regardless of the source, TxC is applied by the modem to pin 15 of the RS-232C connector and is used by the data terminal equipment to time the transmission of serial data on the TD (Transmit Data) circuit. This signal pertains to synchronous communications only. Modem can be programmed to source this signal, or to derive it from either the data terminal equipment (pin 24), or from the receive carrier (slave operation). See discussion of the &X command.

RxC - Receive Clock (pin 17)

Provides the receiver section of the modem with timing information. Modem always derives this signal from the receive carrier, and applies it to pin 17; this signal is used by the data terminal to time the incoming bit stream from the local modem (RD-Receive Data-pin 3). This signal pertains to synchronous communications only.

DTR - Data Terminal Ready (pin 20)

Prepares and maintains the connection to a remote system. The modem can be programmed for a variety of responses to DTR signal, as required for asynchronous or synchronous modes. See discussions of communication modes and &D command.

RI - Ring Indicator (pin 22)

Carries signal to indicate the modem is receiving call signals (ring/tones). The modem turns on this signal whenever an incoming ring is detected.

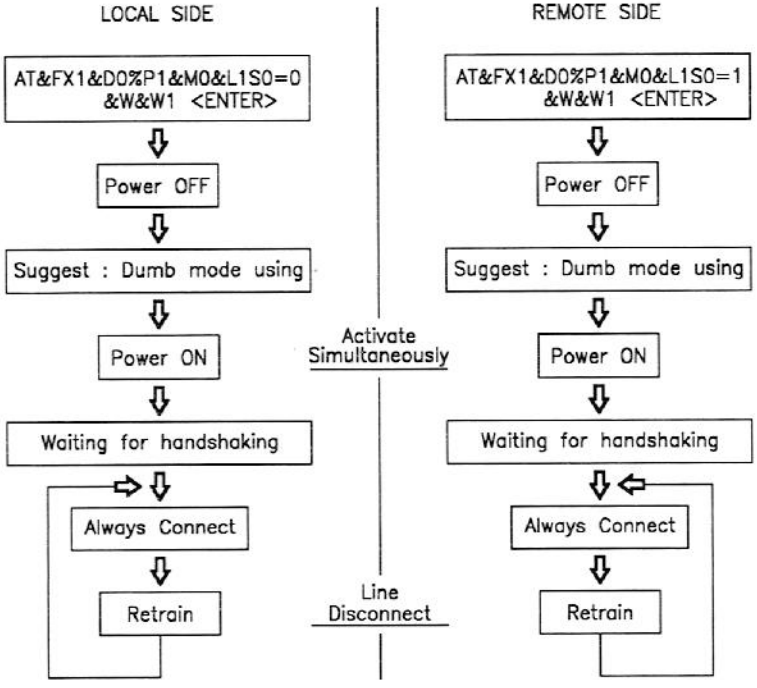
Transmit Clock Source (pin 24)

If the data terminal equipment sources the transmit clock on this pin, the modem can be programmed to use this clock signal rather than its own internal clock. This signal pertains to synchronous communications only. See discussion of the &X command.

Appendix E

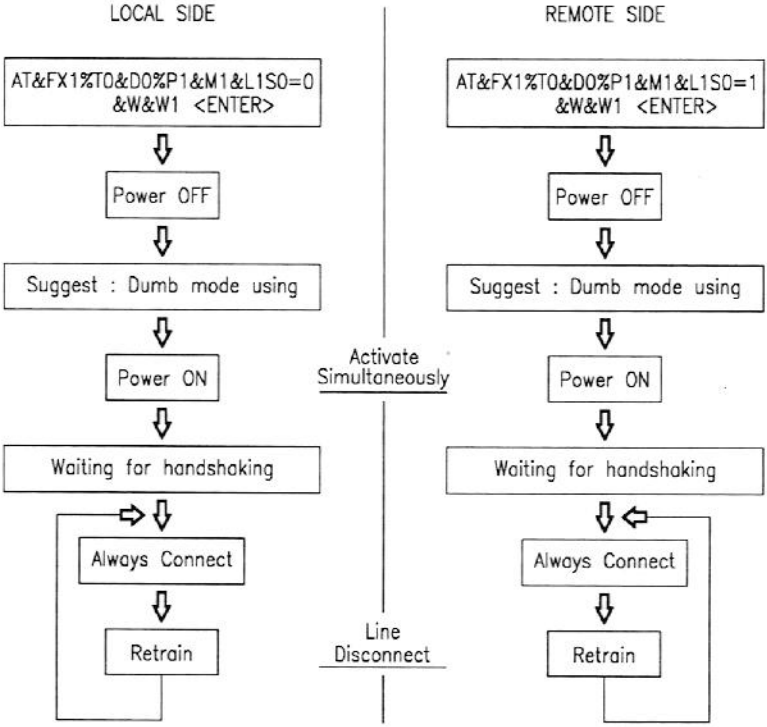
Appication Notes

Subject : Running modem on a Leased Line in Asynchronous mode.



Note: # DTE speed : 14400/9600/4800 bps (asynchronous)
By smart mode and key-in interrupt, the modem will recover to command mode.
The user can add MNP or V.42 bis function through the command.

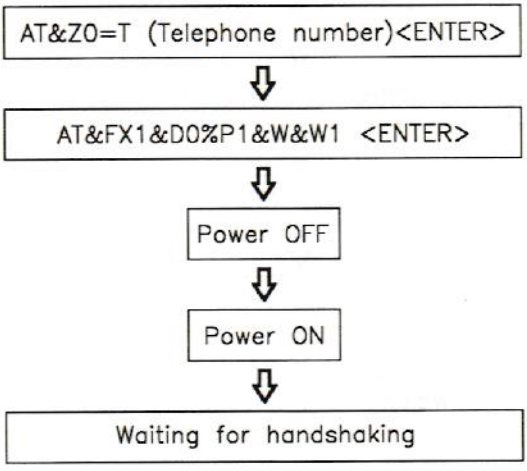
***Subject :Running the modem on a Leased Line in Synchronous mode (IBM 4300)**



Note: # DTE speed : 14400/9600/4800 bps (synchronous)
MNP & V.42 connection are for asynchronous mode only.
By smart mode and key-in interrupt, the modem will recover to command mode.

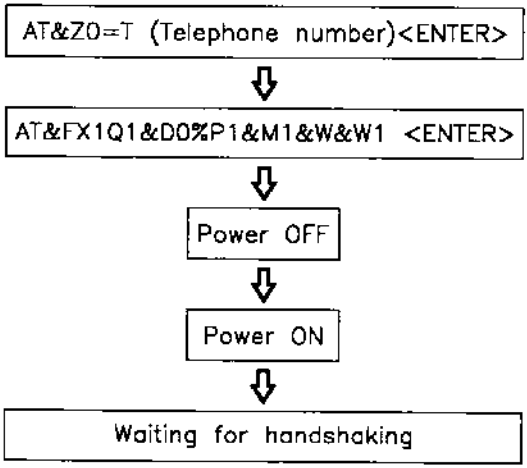
*** This example is for the External Modem only**

Subject : Running the modem on a Dial-up Line in Asynchronous mode.



Note: # In this operation mode, the modem will dial the stored telephone number immediately after power on.
DTE speed : 14400/9600/4800 bps (asynchronous)
MNP or V.42 commands can be added between &F and &W command for reliable mode and data compression mode.

***Subject :Running the modem on a Dial-up Line in Synchronous mode**

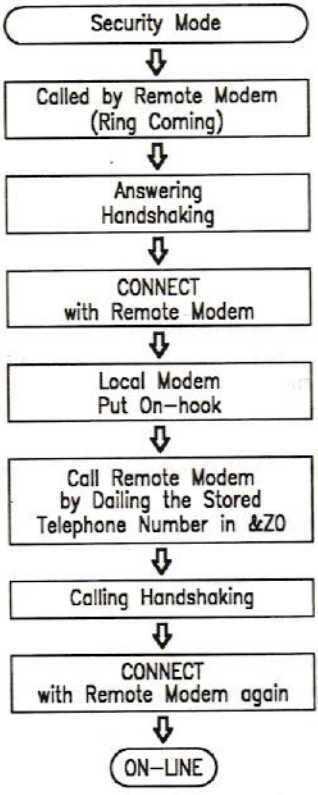


Note: # In this operation, the modem will dial the stored telephone number immediately after power on.
DTE speed : 14400/9600/4800 bps (synchronous)
MNP reliable connection is for asynchronous mode only.

*** This example is for the External Modem only**

Subject: Security Call-back method

AT%S1<ENTER> (call back security enabled)
AT&Z0=XXX XXXX<ENTER> (Store the remote modem's telephone number for call-back use)


Security Mode
Called by Remote Modem (Ring Coming)
Answering Handshaking
CONNECT with Remote Modem
Local Modem Put On-hook
Call Remote Modem by Dailing the Stored Telephone Number in &Z0
Calling Handshaking
CONNECT with Remote Modem again
ON-LINE

Subject : To Configure the modem with Bitcom, Procom , Scom2, and Scom3.

1. Procedure to set up MNP5 operation for Bitcom (V.358A) software:

1) Bitcom <Enter>
2) Select Option : 3
3) MNP Dial Prefix : ATE1V1X4\\N3\\V1\\J1%C1\\Q1DT
   .
   .
   .
   Answer String : ATE1V1X4S0=1\\N3\\V1\\J1%C1\\Q1$0d
4) Key in F2 <Quit>
5) Select Option : 1
6) Key in F10 <Edit>
7) (move cursor)
   MNP : Yes
   (move cursor)
   Ignore : None
8) <Enter> (begin communication)
9) Screen : show connect XXXX / REL COMPRESSED
10) F2 ┬Receive file
    └Send file

2. Procedure to set up MNP5 Operation for Procomm Softwre (V.2.4.2)

1) Set-up terminal speed :
   Alt - P
   Set terminal mode : 9600, N, 8, 1
2)
   [1] Alt - S
   [2] 1 <Enter> (Modem Setup)
   [3] Modem init string AT V1X1S0=1! <Enter>
   [4] 2 <Enter>
   [5] Esc
   [6] Esc
3) Key in MNP Command :
   AT\N3\V1\J%C1\Q1&W&W1 <Enter>
4) Terminal setup :
   [1] Alt - S
   [2] 2 <Enter> (terminal setup)
   [3] 3 <Enter> (flow control)

[4] XON/XOFF (selected)
[5] Esc
[6] Esc

5) Dial :
[1] Alt - D
[2] 1 <Enter> (choose the telephone number you want to dial)
Note : Sending file
[1] Alt - S
[2] 6 <Enter> (ASCII transfer setup)
[3] Pace character - 0
Character pacing - 0
Line pacing - 0

3. Configure the modem for SCOM2 (V.2.0/V.2.1)

Procedures :
[1] SCOM <Enter>
[2] 1 <Enter> (begin communication)
[3] 0 <Enter>
[4] Z <Enter>
[5] XXXX (phone no.) <Enter>
[6] Handshaking
.
.
.

4. Configure the modem for SCOM3 (V.1.0B)

Procedures :
[1] SCOM3 <Enter>
[2] <Enter>
[3] I (Initiate Session)
[4] VT102 Standard Keyboard <Enter>
[5] Originate (COM1) <Enter>
[6] TXXXXXXX <Enter> (enter phone number)
[7] Handshaking
.
.
.